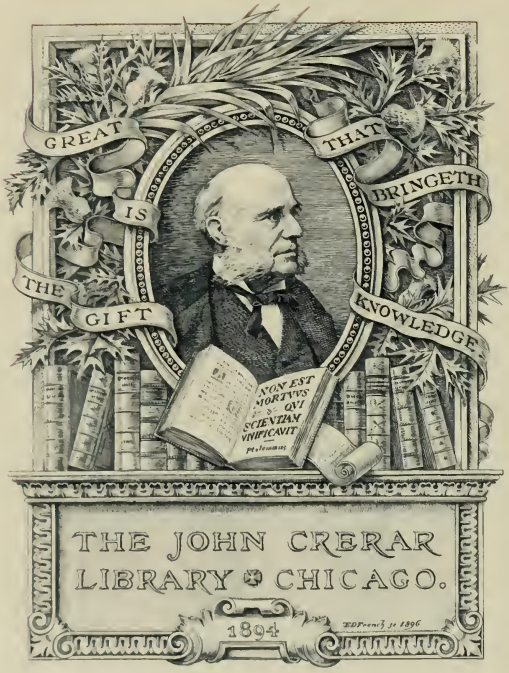
GREAT IS THE GIFT THAT BRINGETH KNOWLEDGE
NON EST MORTVVS QVI SCIENTIAM VIVIFICAVIT
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# REGISTER

OF

# LEHIGH UNIVERSITY

## 1902-1903.

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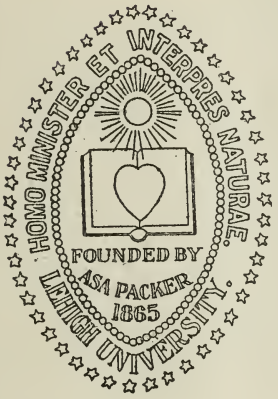
SOUTH BETHLEHEM, PA.

# REGISTER

OF

# LEHIGH UNIVERSITY




## 1902-1903.

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SOUTH BETHLEHEM, PA.

BIBLIOTECA NACIONAL
MADRID

# 1902.

## JULY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## AUGUST.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## SEPTEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | .. | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## OCTOBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## NOVEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | ... | ... | ... | ... | ... | ... |

## DECEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# 1903.

## JANUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

## FEBRUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| ... | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## APRIL.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MAY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## JUNE.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JULY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## AUGUST.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | ... | ... | ... | ... | ... |

## SEPTEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## OCTOBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| .. | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

## NOVEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## DECEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# 1904.

## JANUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## FEBRUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## APRIL.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | .. | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| ... | ... | ... | ... | ... | ... | ... |

## MAY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JUNE.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# CALENDAR.

## 1902–1903.

| | |
|---|---|
| 1902. | |
| Sept. 20, 22, 23, | Examinations for Admission. |
| Sept. 24, 3.30 P.M., | First Term begins. |
| Oct. 9, | Founder's Day. |
| Nov. 26, 12.00 M., | Thanksgiving Recess begins. |
| Dec. 1, 8.15 A. M., | Thanksgiving Recess ends. |
| Dec. 23, 6.00 P. M., | Christmas Holidays begin. |
| 1903. | |
| Jan. 5, 8.15 A. M., | Christmas Holidays end. |
| Feb. 9, 8.15 A. M., | Second Term begins. |
| Feb. 21, | Junior Oratorical Contest. |
| April 8, 12.30 P. M., | Easter Holidays begin. |
| April 16, 7.45 A. M., | Easter Holidays end. |
| May 30, | Memorial Day (half holiday). |
| June 14, | Baccalaureate Sunday. |
| June 15, | Class Day. |
| June 16, | Alumni Day. |
| June 17, | University Day. |
| June 18, | Summer Term begins. |
| June 18, 19, 20, | Examinations for Admission. |

## 1903–1904.

| | |
|---|---|
| 1903. | |
| Sept. 19, 21, 22, | Examinations for Admission. |
| Sept. 23, 3.30 P.M., | First Term begins. |
| Oct. 8, | Founder's Day. |
| Nov. 25, 12.00 M., | Thanksgiving Recess begins. |
| Nov. 30, 8.15 A. M., | Thanksgiving Recess ends. |
| Dec. 23, 12.30 P. M., | Christmas Holidays begin. |
| 1904. | |
| Jan. 5, 8.15 A. M., | Christmas Holidays end. |
| Feb. 8, 8.15 A.M., | Second Term begins. |
| June 15, | University Day. |

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|---|---|---|
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# LEHIGH UNIVERSITY.

## ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

## DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary, and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, Chemistry, Geology, Physics, and in all needful collateral studies. A thoroughly equipped School of General Literature was also established, including the Classical and Latin-Scientific courses.

## SITE.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads, and the University buildings are about a half-mile from the station. New York is eighty-nine and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

## TUITION AND OTHER FEES.

For students in the courses of Civil, Mechanical, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, and Geology, the tuition fee is $150 for the year or $90 for either term; for students in the courses of Chemistry and of Physics, $100 for the year or $60 for either term; for students in the School of General Literature, $60 for the year or $40 for either term. A graduation fee of $10 must be paid by all candidates for a degree.

The special fees for materials and apparatus used in the various laboratories, etc., are given in connection with the description of the subjects under the List of Studies.

The tuition fees are payable to the Treasurer of the University in two instalments. The first instalment, of $90, $60, or $40, according to the course, is to be paid to the Treasurer of the University on or before October 10; the second, of $60, $40 or $20, on or before February 20. A student who has withdrawn more than two months before the end of either term may make application for the return of a part of the tuition fee; but the amount thus refunded will in no case exceed one half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

### POSTPONEMENT OF PAYMENT.

Application may be made for the privilege of postponement of payment of tuition until after graduation by students needing this assistance in order that they may pursue a course at the University. The Committee on Scholarships will grant this aid only upon satisfactory evidence that the applicant is absolutely unable to provide for the payment of tuition.

It is also a condition for granting this privilege that the applicant must take the regular entrance examinations of the University and enter in full standing; and its renewal from year to year will depend on the student's maintaining full standing in all the studies of his course. All applications for postponement of tuition must be made on blanks provided by the University and must be sent to the Registrar before June 1st by those taking the June examinations, and before September 1st by those taking the September examinations.

The recipient of this privilege signs a paper declaring it to be his intention to pay the amount of the tuition fees thus remitted as soon as he is able to do so. He does not in this way accept a benefaction, but assumes a moral obligation which is individual in character and does not affect any member of his family.

## PUBLIC WORSHIP.

Morning prayers are held in the Packer Memorial Church of the University, at which attendance is required.

Divine service is held every Sunday morning in the church. Any student who may desire to attend some other place of worship will be permitted to do so upon the request of his parent or guardian, or, if he is 21 years of age, upon his own request. The request for such permission should be renewed at the beginning of each year. Attendance, either at the Packer Memorial Church or at the church of his selection, is required of every student.

## BUILDINGS.

### PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem, West Bethlehem, and South Bethlehem.

The department of Civil Engineering has, on the first floor, two drawing rooms and three lecture rooms, together with instrument rooms and offices. Here are found collections of bridge models, photographs and blue-prints, specimens of building materials, and also a large number of levels, transits, and other surveying instruments. The testing laboratory in the basement has four machines for tests of tension, compression, flexure, and torsion; a 2000-pound cement machine, and smaller apparatus for special experiments on beams and columns. The cement laboratory has recently been enlarged and its equipment made very complete. The Freshman drawing room of the Civil Engineering department is located on the fourth floor.

The second floor of this building is devoted to the class room and drafting work of the department of Mechanical Engineering.

Here are the various recitation rooms, and the well lighted and equipped drafting rooms for the several classes. Near these are the offices of the professor and instructors, the blue-print room, and the reference library of the department, with its large store of prints and working drawings. A wide range of machinery is illustrated by cuts and photographs on the walls. The drafting rooms are further equipped with an extensive assortment of machine parts in cases, with a full-sized link-motion constructed for Lehigh Valley Railroad practice, and with a small eight-wheel locomotive, which is an exact reproduction on a scale of one-sixth of a standard passenger locomotive.

On the third floor are to be found the lecture and laboratory rooms of the department of Mining Engineering and Geology. The Geological Laboratory is provided with eight Fuess petrological microscopes of high grade and the most recent pattern. About five hundred thin sections of rocks and minerals, and collections of recent shells and corals furnish material for undergraduate and graduate laboratory work. The lecture rooms are provided with typical sets of rocks and fossils for lecture purposes, and also with a stereopticon and micro-projection apparatus. The museum of Geology and Natural History and other class rooms are also on this floor.

This building contains also the lecture and recitation rooms of the departments of Greek, Latin, Modern Languages, and Mathematics.

### THE CHEMICAL AND METALLURGICAL LABORATORIES.

This is a thoroughly fire proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

Photographic and microscopical laboratories are located in the third story of the central portion of the building.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals; a museum for mineralogical and metallurgical collections; a mineralogical laboratory provided with a Fuess reflecting goniometer, Goldschmidt's "two-circle" reflecting and application goniometers, a polariscope, a Groth's "universal apparat," and a Rosenbusch polarizing microscope; a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

## THE LABORATORY OF PHYSICS AND ELECTRICAL ENGINEERING.

This building is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the dynamo laboratory, the work shop, a storage battery room, electrical laboratory room for Junior work, and two research rooms.

The dynamo laboratory is equipped with a 50-horsepower engine, a Brackett cradle dynamometer, eighteen dynamos and motors ranging from 1 horsepower to 50 horsepower, nine small motors, an assortment of transformers, and a variety of measuring instruments and appliances.

A mechanician is regularly employed in the shop, which is well equipped for the repairing and manufacturing of apparatus.

On the second floor are the department offices, drawing room, seminary and reading room, apparatus rooms, and large laboratory rooms for general physics.

On the third floor are the physics lecture room with apparatus rooms adjoining, photographic and photometer rooms, a recitation room, and a large audience hall. A room on this floor is fully equipped for X-ray work in connection with St. Luke's Hospital.

On the fourth floor well lighted by dormer windows and skylights are three recitation rooms in the central portion of the building, a large drawing room and a blue-print room in the east wing, and a freehand drawing room in the west wing.

### STEAM ENGINEERING LABORATORY.

This is a new, well lighted, two story building of Potsdam sandstone, 90 feet long and 44 feet wide. It is divided into two sections, one for boilers and the other for engines. The former can accommodate three 100-horsepower high pressure boilers and the latter the various steam motors and their accessories. In this experimental power plant are contained a triple-expansion engine, a tandem-compound marine engine, a high-speed Ball engine (Erie, Pa.), coupled to a 25 K. W. Crocker-Wheeler generator, an Ingersoll-Sergeant Drill Co. air compressor which is compound at both air and steam ends, with reheating and cooling devices attached, and a DeLaval steam turbine that is combined with a centrifugal pump. The accessories are a Wilson-Snyder steam pump, a Blake pump, a Worthington circulating pump, a "Featherweight" air pump, a Cochrane feed-water heater and three Cochrane steam separators, also box-coil condensers, a Wheeler surface condenser, and Wainwright surface condenser. There is a complete set of Westinghouse air brake apparatus including the pump and engineer's valve, and several sets of the parts belonging to freight cars. In addition there are water meters, weighing tanks, and dynamometers for measuring the steam consumption and the development of power.

In the basement of Williams Hall an additional space of 3600 square feet is provided for other experimental work, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiences of hoisting and other gear, and the testing of motors and other prime movers than steam engines. In this section there are 4-cycle and 2-cycle gas engines, hot-air pumping engines, electric motors, a water motor, a 15-horsepower centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

### WILLIAMS HALL.*

Williams Hall, which will be ready for occupancy in September, 1903, has a frontage of 186 feet, a depth of 70 feet, and covers a ground area of 12,000 square feet. One-half of the building will

*Named for Prof. E. H. Williams, jr.

be devoted to geology, biology, and mining engineering, and the other half to the department of mechanical engineering. A large part of the basement will be used for laboratory work in experimental mechanics and engineering physics, and the remaining three stories will contain drawing and recitation rooms, museums, reference libraries, and instructors' studies.

### SAUCON HALL.

Extensive alterations to this building were made in 1896, adapting it to the needs of the departments of English, of History and Economics, and of Philosophy. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the Debating Society, with committee rooms adjoining.

### CHRISTMAS HALL.

In this building are found the drawing rooms of the Metallurgical department and the halls of the Young Men's Christian Association. On the ground floor is a Supply Bureau conducted by students of the University.

### THE SAYRE OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt; and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

### THE PACKER MEMORIAL CHURCH.

The Packer Memorial Church is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent churches in the State.

## THE UNIVERSITY LIBRARY.

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than $20,000 was contributed by her family and friends as a memorial fund for the purchase of books.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied as a reading space, 50 by 40 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well lighted, and heated by steam.

One hundred and seventeen thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about four hundred, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

### The Eckley B. Coxe Memorial Library.

In memory of the Honorable Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe has presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

## THE GYMNASIUM.

The Gymnasium is a spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus and two bowling alleys, and is provided with hot and cold water, and shower baths, and 515 clothes closets.

## EXPENSES.

Books and drawing instruments are furnished by the student. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit or fee made at the opening of that term in which the laboratory work is to be done. These fees and deposits for the various laboratories are given under the detailed statement of laboratory courses in the List of Studies.

Rooms and board cannot be had in the University buildings, but can readily be obtained in many private houses in South Bethlehem and Bethlehem.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $350 to $500. This includes attendance at the required summer schools.

*Fee for Special Examinations.*—Special examinations, granted by the Faculty to students at their request, are subject to a fee of five dollars, which is added to the President's Fund for the aid of indigent students.

## ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the Registrar if information is desired which is not given in the Register.

### DATE OF EXAMINATIONS.

Examinations for admission to the University will be held in 1903 on Thursday, Friday, and Saturday, June 18, 19, and 20, and on Saturday, Monday, and Tuesday, September 19, 21, and 22. All applicants must be in attendance at 8 o'clock on the morning of the first day.

The examinations are held in June and September in the following order:

*First Day.*—Geometry, 8:00 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

*Second Day.*—Algebra 8:00 A.M.; English, 2 P.M.

*Third Day.*—Trigonometry, 8:00 A.M.; American History, 11 A.M.; German or French, 2 P.M.; Greek and Greek History, 2 P.M.

Examinations are held for admission to the Sophomore Class at the beginning of the first term; information as to these examinations may be obtained from the Registrar.

The examinations cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his latest instructor.

Certificates of the College Entrance Examination Board are accepted in lieu of the examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

## THE SCHOOL OF GENERAL LITERATURE.

### THE CLASSICAL COURSE.

Candidates for admission to the classical course are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition*. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

*History.*—This requirement includes: (*a*) *Greek History* to the death of Alexander, with due reference to Greek life, literature, and art. (As in Botsford, Myers, or Oman, with Mahaffy's Old

Greek Life); (*b*) *Roman History* to the accession of Commodus, with due reference to literature and government. (As in Myers's Rome or Allen's History of the Roman People, pp. 1-242, and in Preston and Dodge's Private Life of the Romans); (*c*) *American History*, with the elements of civil government. This includes colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin). Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Plane Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of metric units.

5. *Latin Grammar.*

6. *Caesar*, four books of the Gallic War.

7. *Cicero*, six orations, including the four against Catiline.

8. *Vergil*, the first six books of the Aeneid, including Prosody.

9. The translation, at sight, of passages from Caesar and Cicero.

10. The translation of English into Latin.

11. *Greek Grammar.*

12. *Xenophon*, Anabasis, four books.

13. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

14. The translation, at sight, of a passage from some work of Xenophon.

Candidates for admission to the Classical Course who have had, in their preparatory schools, no opportunity of studying Greek, are, at present, admitted to that course in full standing upon presenting in lieu of Greek an amount of German or French equivalent to two years' work. They will begin Greek in the University and study it throughout the course.

### THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first ten of the above requirements, but substitute for the Greek sections (numbers 11-14 inclusive) the following work:

15. *Solid Geometry.*

16. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

17. Two Years' Work in either *German* or *French.* This requirement will be satisfied by the completion of an amount of German equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, and Buchheim's Reader, Part I, together with about 500 pages of standard German authors; or, if French is offered, an amount equivalent to Whitney's Practical Grammar and Super's Reader, together with about 800 pages of modern French authors.

The candidate is expected to have acquired the ability to read German or French prose and poetry of ordinary difficulty. His proficiency will be tested by questions on Grammar, by translation of simple English sentences into German or French, and by translations at sight of passages containing no rare or unusual words.

## THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining Engineering, Metallurgical Engineering, Electrometallurgy, Electrical Engineering, Chemistry, Chemical Engineering, Geology, and Physics are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition.* Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and

intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *American History*, with the elements of civil government. This will include colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles. Solid geometry.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric units.

5. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

**All mathematical subjects should be thoroughly reviewed in the last year's work of the Preparatory school.**

6. *Elementary Physics.*—This requirement may be met by a good course in any of the standard High School text-books in Physics, such as Gage's Elements of Physics, Carhart and Chute's Physics, or Avery's Elements of Natural Philosophy. Ability to solve simple numerical problems is required. In case the can-

didate has done laboratory work in Physics he should submit his laboratory note book at the time of his examination for entrance.

7. *German.*—This requirement will be satisfied by the completion of an amount equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

[An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.]

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions on the rudiments of grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

### DIVISION OF EXAMINATIONS FOR ADMISSION.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June and the rest in September of the year of entrance, or may take them in *two consecutive years.* In the last case, for all courses candidates may present themselves for examination in the first year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the Classical and Latin-Scientific Courses may present Latin: Grammar, Caesar, Cicero; and one of the following: (*a*) Greek: Grammar and three books of Anabasis; (*b*) German: the equivalent of one year's work; (c) French: the equivalent of one year's work.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

### ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course,* examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class. The ad-

ditional subjects may be found in the schedule of studies of the different departments.

Students from other Colleges or Universities are admitted without entrance examinations, provided they have covered the entrance subjects required at this University. Evidence to that effect, together with a letter of honorable dismissal from their college, should be first filed with the Registrar. If these are satisfactory, the applicant will receive a certificate that the entrance requirements of this University are satisfied.

Applicants who have obtained this certificate and who desire to enter the Freshman or Sophomore class in February, will report personally to the Secretary of the Faculty on or before the Wednesday preceding the opening of the second term. Those who desire to enter the Sophomore or Junior class in September must report personally in June on the Thursday preceding University Day, or in September on the Thursday preceding the opening of the first term.

The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects already taken by the class that he desires to enter. Professors are at liberty to examine formally an applicant in these subjects, but as a rule this will not be done if he furnishes satisfactory evidence of proficiency. It is important that the applicant should bring samples of his drawings, field notes, computations and laboratory work for the inspection of professors, personal certificates from his teachers showing the grades attained at the college from which he comes, and also a copy of the catalogue or register of his college.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within three days from its date of issue. If all the subjects are noted as accepted, the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are noted as accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

### ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree con-

ferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Courses.

### PREPARATORY SCHOOL CERTIFICATES.

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations, and the acceptance of certificates for any student in any subject must be the result of a special arrangement between the Principal of the school and the Registrar of the University.

### EXAMINATIONS AT SCHOOLS.

When desired by the Principals, arrangements will be made to hold at the schools the June examinations for admission to the University.

# LIST OF STUDIES.

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figure in parentheses. Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

## GRADUATE COURSES.

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any College or University, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases graduates of this University who are candidates for the degree of Master of Arts may be allowed to study in non-residence.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any College or University, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The tuition fee is $50 a year and the graduation fee is $10. No tuition is charged to students pursuing graduate work in non-residence, but the graduation fee is $30, and at least two years are required to complete the course.

The course of study may be selected, with the approval of the Faculty, from the following list of subjects, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department and about one-third in another, these being called major and minor departments. The thesis is to be prepared on a subject connected with the studies of the major department. The candidate is required

to satisfy each professor that he is fully competent to pursue the subjects selected.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

Candidates who expect to receive the Master's degree in June of 1904 are required to confer with the professors on or before September 26, 1903, and to present their courses of study to the Faculty for approval on September 28, 1903.

## IN SANITARY SCIENCE.

### The Mechanical, Chemical, and Biological Purification of Water and Sewage.

PRESIDENT DROWN.

A critical chemical and biological study of the results of recent investigations that have been carried on in Europe and in this country into the methods proposed and those in use for the removal or destruction of the organic and inorganic impurities of water and sewage. Two terms. (4)

## IN CHEMISTRY.

### Advanced Industrial Chemistry.

PROFESSOR CHANDLER.

This course involves the study of some industry dependent upon chemical principles and consists of practical experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms. (10)

### The Rare Elements.

MR. SPANUTIUS.

The study of the properties and reactions of these elements and the preparation of some of their salts. Two terms. (10)

### Advanced Organic Chemistry.

DR. SCHOBER.

This course consists of original investigations in organic chemistry. Two terms. (10)

### Advanced Inorganic Chemistry.

DR. ULLMANN.

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms. (10)

## IN MINERALOGY.

### Geometric Crystallography.

ASSISTANT PROFESSOR RICHARDS.

The course comprises advanced study in mathematical crystallography, including stereographic and especially gnomonic projection, with the theoretical views of crystallogeny developed by the latter. Further, practical crystal measurements with the two-circle or theodolite goniometer of Goldschmidt, projection of results gnomonically, and discussion of crystallographic constants thus determined. First term. (5)

### Physical Crystallography.

PROFESSOR FRAZIER.

This course consists of a description and discussion of the physical properties of crystals, especially their optical behavior. Works of reference: Mallard's Crystallographie Physique, Groth's Physikalische Krystallographie, and Liebisch's Physikalische Krystallographie. In addition, practical instruction is given in the determination of the optical constants of crystals. Second term. (5)

## IN CIVIL ENGINEERING.

### Testing of Materials.

PROFESSOR MERRIMAN.

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms. (5)

### Railroad Engineering.

PROFESSOR MERRIMAN.

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wel-

lington's treatise, with the detailed discussion of special cases. Two terms. (2)

### Sanitary Engineering.

MR. ROGERS.

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms. (4)

### Bridge Design.

MR. HYDE.

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparisons of different types. Two terms. (4)

## IN MODERN LANGUAGES.

### German.

PROFESSOR RINGER.

An advanced course in the German language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

### French.

PROFESSOR RINGER, MR. GAUSS.

An advanced course in the French language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

## IN GEOLOGY.

### Geology.

ASSISTANT PROFESSOR BARRELL.

The identification of rocks and the tracing of boundary planes under capping; the value of fossils in determining zones; the construction of maps and sections; and practice in taking field notes. Field work is done in the vicinity of the University, where formations from the Archaean to the Triassic outcrop and where glacial deposits cover the regions to the north. Second term. (6)

### Physiography.

ASSISTANT PROFESSOR BARRELL.

The classification of land forms; their stages of development; their value as indicators of the geological history of the land; their dependence on climatic and geographic distribution. Lectures, assigned readings and studies in the field. Preparation required: 166 or 167 and 168. First term. (3)

### Paleontology.

DR. HALL.

The study of the characteristic genera of fossil animals in detail, their structure, relationship, and geological range. Lectures and laboratory work. Preparation required: 178. 179 will be found advantageous.

### Vertebrate Embryology and Organology.

DR. HALL.

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, beginning with the segmentation of the egg and tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 178, 179, and 180. First term. (3)

## IN MATHEMATICS AND ASTRONOMY.

### Practical Astronomy.

PROFESSOR THORNBURG.

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longtitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms. (4)

### Analytical Mechanics.

ASSISTANT PROFESSOR MEAKER.

This course is based on Ziwet's Theoretical Mechanics and Routh's Dynamics of a System of Rigid Bodies. Two terms. (3)

### Differential Equations.

ASSISTANT PROFESSOR LAMBERT.

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms. (3)

## IN ENGLISH.

### English Literature.

PROFESSOR THAYER.

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms. (5)

## IN PHYSICS AND ELECTRICAL ENGINEERING.

### Theoretical Physics.

PROFESSOR FRANKLIN.

This embraces: (*a*) The theory of heat, based upon Preston's Theory of Heat and Buckingham's Thermodynamics; (*b*) The theory of electricity and magnetism, based upon Maxwell's Treatise, J. J. Thomson's Recent Researches, and Webster's Electricity and Magnetism; or (*c*) The theory of light and sound, based upon Preston's Theory of Light and Helmholtz's Tonempfindungen. Two terms. (4)

### Theory of Alternating Currents.

ASSISTANT PROFESSOR ESTY.

This course is based upon the works of Bedell and Crehore, of Steinmetz, and of Franklin and Williamson. Two terms. (2)

### Physical Research.

PROFESSOR FRANKLIN.

This course consists of original investigations in experimental physics. Two terms. (3)

### Electrical Testing.

ASSISTANT PROFESSOR ESTY.

This course consists of investigations in electrical engineering. Two terms. (3)

## IN PHILOSOPHY.

### Philosophy.

PROFESSOR STEWARDSON.

Introspective and physiological psychology. The History of Philosophy in general together with special study of either the Greek, German, or English philosophers. Two terms. (5)

## IN HISTORY AND ECONOMICS.

### Political Economy.

PROFESSOR STEWART.

This course embraces: (*a*) The rise and development of economic systems and economic thought; (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn, and Ingram on Political Economy will be used. Two terms. (5)

### American History.

PROFESSOR STEWART.

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms. (5)

### Politics.

PROFESSOR STEWART.

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's History of the Science of Politics and Sidgwick's Element of Politics. Two terms. (5)

## IN LATIN.

### Roman Law.

PROFESSOR BLAKE.

(*a*) Roman law before Justinian: based on Bruns's Fontes Juris Romani Antiqui, and Mommsen's Abriss des römischen Staatsrechts. (*b*) Justinian's Institutes, Morey's Outlines of Roman Law, and collateral reading. Two terms. (4)

### Roman Philosophy.

PROFESSOR BLAKE.

(*a*) Cicero, De Legibus and De Natura Deorum; History of Roman Philosophy. (*b*) Selected readings from Seneca. Two terms. (3)

### Roman Literature.

PROFESSOR BLAKE.

(*a*) History of Roman literature. (*b*) Readings from Latin authors not previously read in course, as far as practicable paralleling the work in (*a*). Two terms. (3)

## IN GREEK.

### Hellenistic Greek.

PROFESSOR GOODWIN.

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms. (5)

### Dramatic Poetry.

PROFESSOR GOODWIN.

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms. (5)

### Greek Philosophy.

PROFESSOR GOODWIN.

Plato's Republic and other works. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms. (5)

## UNDERGRADUATE COURSES.

The University offers the following four year courses:

I. In the School of General Literature:
1. The Classical Course.
2. The Latin-Scientific Course.

II. In the School of Technology:
1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Metallurgical Engineering.
4. The Course in Electrometallurgy.
5. The Course in Mining Engineering.
6. The Course in Electrical Engineering.
7. The Course in Chemistry.
8. The Course in Chemical Engineering.
9. The Course in Geology.
10. The Course in Physics.

These courses are described in detail on pages 71 to 104 of the Register.

### PHILOSOPHY.

PROFESSOR STEWARDSON.

1. Psychology. Lectures on the connection of mental with physiological processes. Cerebral localization. The structure and function of sense organs. The phenomena of sensation. No laboratory work. Text-book: William James's Psychology, school edition. First term. (2)

2. Psychology. The phenomena of reason and will. Lectures on association, memory, attention, imagination, apperception, reflection, volition. Text-book: William James's Psychology, school edition. Second term. (2)

3. History of Philosophy. Lectures on Greek philosophy and medieval philosophy with recitations. Text-book: Weber's History of Philosophy (translated by F. Thilly). First term. (2)

4. History of Modern Philosophy, with special attention to Ethics. Readings from Locke, Berkeley, and Hume. Text-book: Weber's History of Philosophy. Second term. (2)

5. Philosophy of Religion. This course consists of from twelve to fourteen lectures and is designed to give the students

an oversight of the more important religions of the world, together with an insight into the essential character of religion and the main lines of its development. Second term. (1)

## ECONOMICS AND POLITICS.

PROFESSOR STEWART.

6. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

7. Economics. Practical economic problems: taxation, transportation, finance, labor, trusts and monopolies. Second term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

8. Economics. History of the industrial change in the 18th and 19th centuries, particularly the economic development of England and the United States. First term. (2)

9. Economics. Studies in the development of modern theories of economics. Second term. (2)

10. Politics. Constitutional Law. Studies in Federal and State constitutional law. First term. (2)

11. Politics. Comparative Constitutional Law. Studies of the English, German, and French political organizations. Second term. (2)

## HISTORY.

PROFESSOR RINGER.

12. European History. Political History of Europe from Congress of Vienna, 1815, to Congress of Berlin, 1878. First and Second terms. (1)

PROFESSOR STEWART.

13. History. Europe and America in the 16th and 17th centuries. Growth of the British colonial interests. The War for American Independence. Second term. (2)

14. History. Formation of the Federal Constitution. Development of political parties. Economic progress of the country previous to 1860. The struggle over secession. First term. (2)

15. History. The United States since 1865. Effects of the war upon the economic and social life of the Union. The industrial expansion and its relation to political organization. Second term. (2)

## LANGUAGES.

### LATIN.

PROFESSOR BLAKE.

16. Livy. Selections from Books I, XXI, and XXII. Cicero, De Senectute, and De Amicitia. Particular attention to forms and the usages of normal syntax. Writing of Latin prose exercises based upon the selections read. Written translations from Latin into English. History of the struggle between Rome and Carthage. First term. (4)

17. Horace. Odes and Epodes. Catullus. Selections from the Georgics of Vergil, from Ovid, or from the minor poets. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Writing of brief original dissertations on topics assigned in connection with Horace. Historical review of Roman lyric and elegiac poetry. Second term. (5)

18. Pliny. Selected letters. Tacitus. Agricola and Germania. Latin prose composition based upon epistolary models. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. First term. (3)

19. Plautus and Terence. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Second term. (3)

20. Horace. Selected Satires and Epistles, and Ars Poetica. Consideration of the philosophy and literary art of Horace. Second term. (2)

21. Tacitus. Selections from the Histories and Annals. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. First term. (3)

22. Juvenal. Selected Satires. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Second term. (3)

23. Lucretius. Careful study of one book entire of De Rerum Natura, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient material-

istic theories. Some review of Roman philosophy and ethics. First term. (3)

24. Roman Law. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's Outlines of Roman Law. Second term. (3)

## GREEK.

### PROFESSOR GOODWIN.

25. Xenophon. Oeconomicus or Hellenica. Review of the Grammar. Prose Composition. Sight-reading. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. One hour a week is devoted to composition and a variety of practical exercises. First term. (4)

26. Herodotus. One book, with sight-reading. Grammar and Composition. Study of the forms and syntax of the Ionic Dialect. Practical Exercises continued. Second term. (4)

27. Lysias. Selected Orations. Prose syntax. Practical exercises, including composition, are given once in two weeks. First term. (3)

28. Euripides. Alcestis, Hippolytus, or Bacchae. Plato. Euthyphro, or Apology. Literary study of the drama and of Plato. Poetical language, style, and conception. Metres. Introduction to Greek Philosophy. Composition continued. Second term. (3)

29. Thucydides. One book; or Demosthenes. Selected Orations. Second term. (2)

30. Sophocles. Oedipus Tyrannus, or Antigone. Aeschylus. Agamemnon, or Prometheus Bound. Literary study of the drama continued. Practice in metrical reading. Text-criticism. First term. (3)

31. Plato. Selected shorter dialogues. Plato as philosopher and literary artist. Second term. (3)

32. Aristophanes. Clouds, Frogs, or Birds. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. First term. (3)

33. Lyric Poetry. Smyth's Greek Melic Poets. Selections from Pindar, or Theocritus. Study of the development of poetry in Greece. Second term. (3)

34. Hellenistic Greek. New Testament. Selections from Lucian. To be substituted on occasion for 33. Second term. (3)

## FRENCH.

PROFESSOR RINGER,

MR. GAUSS, MR. PALMER, MR. STIDMAN.

35. Elementary French. Whitney's French Grammar. Kuhn's French Reader. First term. (2)

36. Elementary French, Continued. Grammar and Reader. Dictation. Reading of short stories from different authors. Second term. (2)

37. French. More advanced work in the Grammar. Reading of Le Cachet Rouge, deVigny; Sans Famille, Malet; La Mare au Diable, George Sand. Dictation. First term. (3)

38. French. Selections from modern authors and readings from Molière, Corneille, and Racine. Dictations. Second term. (3)

(Courses 37 and 38 are for Freshman year of those who entered on French.)

39. French. French Composition. Dictations. Translation from English into French. Thorough study of several tragedies by Racine and Corneille. First term. (2)

40. French. Lectures on French Literature based on Brunetière's Manuel de l'Histoire de la Littérature Française. Selections from Victor Hugo, Lamartine, deMusset, and the modern historians. Second term. (2)

41. French. Historical Grammar. Darmstetter's History of the French Language. Composition. First term. (2)

42. French. Lectures in French on the literature of the 18th century, with special reference to the Encyclopedists. Composition. Second term. (2)

43. French. Lectures in French on the French Dramatists up to the Romantic School. First term. (2)

44. FRENCH. Lectures in French on the Historians of the 19th century and the Dramatists of the Romantic School. Second term. (2)

Courses 42 and 44 will be given in alternate years.

An optional course in French conversation is open to students of all classes. (1)

## GERMAN.

PROFESSOR RINGER,

MR. GAUSS, MR. PALMER, MR. STIDMAN.

45. ELEMENTARY GERMAN. Joynes-Meissner's Grammar. Joynes's German Reader. First term. (2)

46. ELEMENTARY GERMAN, CONTINUED. Joynes-Meissner's Grammar. Dictation. Reading of short stories from different authors. Second term. (2)

47. GERMAN. More advanced work in the Grammar. Dictation. Reading of more difficult German prose. First term. (3)

48. GERMAN. Continuation of course 47. Reading of Freytag's Aus dem Staat Friedrichs des Grossen, and some of the masterpieces of Lessing, Schiller, and Goethe. Second term. (3)

(Courses 47 and 48 are for Freshman year of those who entered on German.)

49. GERMAN. Jageman's Prose Composition. Dictation. Translation from English into German. Reading of the dramatic masterpieces of Lessing, Schiller, and Goethe, and the poems of Heine. First term. (2)

50. GERMAN. Lectures on German Literature based on Scherer's History of the German Literature. Original compositions. Reading of German Classics. Second term. (2)

51. ADVANCED GERMAN. Advanced Grammar. History of the German Language. Composition. First term. (2)

52. GERMAN. Lectures in German on the Dramatists and Historians of the 19th century. Second term. (2)

53. GERMAN. Lectures in German on Lessing and Herder. Composition. First term. (2)

54. GERMAN. Lectures in German on Schiller and Goethe. Second term. (2)

Courses 52 and 54 will be given in alternate years.

An optional course in German conversation is open to students of all classes. (1)

## SPANISH.

MR. GAUSS.

55. (Elective). Elementary Spanish. Loiseaux's Spanish Grammar. Reading of easy modern Spanish. Dictation. Drill in Spanish conversation. First term. (2)

56. (Elective). Elementary Spanish, Continued. Continuation of course 55. Reading of more difficult Spanish. Writing of short themes and practice in talking Spanish. Second term. (2)

The courses in Spanish are open to all students of the University, but cannot be accepted as the equivalent of French or German.

## ENGLISH.

PROFESSOR THAYER, DR. WHITMAN, MR. COLEMAN.

57. Rhetoric. A composition course based on Genung's Working Principles of Rhetoric, involving recitations and weekly themes on assigned subjects. First term. (2)

58. American Literature. Lectures on the basis of Pattee's History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's note-book. First term. (1)

59. History of the English Language. Lectures and classroom work, with the use of Lounsbury's History of the English Language as a text-book, supplemented by Emerson's and Champneys's. Second term. (2)

60. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Stopford Brooke's English Literature. First term. (2)

61. Literary Criticism. The subject varies annually, but is always taken from the Elizabethan Period. For 1903 it will be a critical study of the Elizabethan Literature (non-dramatic), including Milton's Poetry and Prose; supplemented by lectures on the Drama. Second term. (2)

62. Essays, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

63. Essays, on subjects based on English Literature. Six essays a year meet this requirement.

64. English Literature of the Earlier 19th Century, 1798-1830. A lecture course based on Saintsbury's XIXth Century Literature. First term. (1)

65. Oratory. A formal course based upon Baker's Principles of Argumentation and Baker's Specimens of Argumentation, with recitations and the writing of Briefs. First term. (1)

66. Anglo-Saxon. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term. (3)

67. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris, and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 66. Second term. (3)

68. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term. (3)

69. Poetics. A course based on Gummere's Handbook of Poetics, Corson's Primer of English Verse and the use of Palgrave's Golden Treasury, Schelling's Elizabethan Lyrics, The Oxford Book of English Verse and Cook's The Art of Poetry, with practical exercises in verse-composition. Second term. (3)

70. To Seniors who wish to carry their linguistic work a little further, into the field of Teutonic philology, a course, alternative with 69, is offered, based upon Wright's Gothic Primer and Sweet's Icelandic Primer. Preparation required: 66 and 67. Second term. (3)

71. Optional courses on the Rise and Development of the English Novel and on the English Poets of the 19th Century (1830-1900) are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

### PUBLIC SPEAKING.

MR. EMERY.

72. PUBLIC SPEAKING. Practical instruction in Declamation, for all Freshmen. Second term. (1)

73. PUBLIC SPEAKING. Original Orations on topics of current interest by all Sophomores. First term. (1)

## MATHEMATICS AND ASTRONOMY.

PROFESSOR THORNBURG,

ASSISTANT PROFESSOR MEAKER, ASSISTANT PROFESSOR LAMBERT,

MR. OGBURN, DR. JAMES, DR. MILLER.

74. ADVANCED ALGEBRA, beginning with theory of quadratic equations and completing the subject. First term. (3)

75. TRIGONOMETRY. Spherical Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 74 and 76. First term. (1)

76. SOLID GEOMETRY, beginning with Book VII and completing the subject. Preparation required: 74. First term. (1)

77. TRIGONOMETRY. Plane and Spherical Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 76. Second term. (3)

78. ELEMENTARY MECHANICS. Statics and dynamics with solutions of numerous illustrative and practical problems. Preparation required: 75. Second term. (5)

79. ANALYTIC GEOMETRY. Graphic representation of loci on cross-section paper, plane and solid analytic geometry. Preparation required: 77 or 78. First term. (5)

80. DIFFERENTIAL AND INTEGRAL CALCULUS. Embracing applications to analytical geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 79. Second term. (5)

81. ANALYTICAL MECHANICS. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 80. First term. (2)

82. DESCRIPTIVE ASTRONOMY. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 80 or 79 and 191. First term. (3)

83. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 80 and 82. Second term. (2)

## FREEHAND DRAWING.

MR. GELHAAR.

84. Freehand Drawing, with especial reference to architecture, construction and machine parts. First term. (2)

## CIVIL ENGINEERING.

PROFESSOR MERRIMAN,

MR. SCHNEIDER, MR. ROGERS, MR. HYDE, MR. RICE.

85. Projection Drawing. The use of instruments. Tracing and lettering. The descriptive geometry of projections, intersections, and developments. Isometric drawing. Plans, elevations, and sections of simple structural details from actual measurements. Preparation required: 76, 84. Second term. (3)

86. Structural Drawing. Plans, elevations, and sections are made from actual measurements of structures. Problems in stone cutting, including drawings for buttresses, piers, culverts, and arches. The use of water colors. Preparation required: 84, 85. First term. (2)

87. Land Surveying. The theory and computation of areas, dividing land, and determining heights and distances. Preparation required: 75. Second term. (1)

88. Land Surveying. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Exercises in map drawing and in the plotting of field notes. Preparation required: 85, 87. Second term. (3), also in Summer term, four weeks, beginning June 18, 1903. A fee of $15 is required for all except students in courses in Mining Engineering and Geology.

89. Topographic Surveying. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed

field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 88. Summer term, four weeks, beginning June 18, 1903.

90. Railroad Surveying. Reconnaisance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 88, 89. Second term. (5)

91. Geodetic Surveying. Elements of the method of least squares and its application to the adjustment of triangulations. The figure of the earth. Field work in triangulation and in the determination of azimuth. Preparation required: 80, 82, 89. First term. (3)

92. Construction. Lectures on timber, stone, mortar, and concrete and on their use in structures. Visits of inspection with written reports on structures. The construction of roads, streets, and pavements with the methods for their drainage and repair. Lectures on the history of engineering. Preparation required: 84, 85. First term. (2)

93. Construction. Lectures on foundations with piles, cribs, coffer dams, and caissons. Visits of inspection, with written reports. Lectures on river and harbor improvements, on tunnels and canals, and on engineering work in progress of construction. Preparation required: 92. Second term. (2)

94. Construction. The theory and design of masonry walls, dams, and arches by both graphic and analytic methods. Lectures on cements and mortars, each student making all the standard tests in the laboratory. Visits to cement manufactories and to engineering works, with written reports thereon. Preparation required: 78, 80, 93. First term. (3)

95. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 94. Second term. (2)

96. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Each

student performs twelve experiments in the testing laboratory, which is equipped with 20,000, 100,000 and 150,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion, and other apparatus for special work. Preparation required: 78, 80. First term. (4)

97. MATERIALS. The materials of construction with reference to inspection and testing. Application of the theory of elasticity to the determination of true internal stresses. Theory of combined steel and concrete constructions. The stresses in guns. Preparation required: 96. First term. (2)

98. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 78, 85. First term. (2)

99. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to simple cases. Analysis of stresses in bridge trusses under dead loads. Retaining walls and masonry arches. Preparation required: 78, 86. First term. (4)

100. ROOFS AND BRIDGES. The theory and computation of stress in roof and bridge trusses under dead, live, and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 99. Second term. (4)

101. BRIDGE DESIGN. The design of bridge floors and trusses. Sketches of details of bridges in the vicinity. Computations and working drawings are made from specifications for a railroad bridge of short span, and estimates of its weight are prepared. Preparation required: 96, 100. First term. (5)

102. BRIDGES. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. Methods of analysis for statically indeterminate structures. Preparation required: 96, 101. Second term. (2)

103. PERSPECTIVE. Shades, shadows, and linear perspective. The construction of perspective views of buildings from plans and elevations. Preparation required: 85, 86. First term. (2)

104. ARCHITECTURE. Architectural styles and the history of architecture. Freehand drawing of columns, doorways, and other details. Simple original designs. Preparation required: 103. First term. (2)

105. Architectural Design. The design of brick and stone houses, including the preparation of plans and specifications. Preparation required: 96, 104. First term. (2)

106. Architectural Design. The design of steel trusses and three-hinged arches for trainsheds. The design of tall steel buildings. Preparation of plans and specifications. Building superintendence. Preparation required: 102. Second term. (3)

107. Heating and Ventilation. Methods of heating buildings with hot air, hot water, and steam. Methods of ventilation by flues and by forced blast. Details of boilers, piping, radiators, and ventilating appurtenances. Preparation required: 78, 80. Second term. (2)

108. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 78, 80. Second term. (3)

109. Sanitary Engineering. Systems of water supply, including purification systems, reservoirs, pipe lines, and pumping plants. Visits of inspection. Preparation required: 94, 108. First term. (3)

110. Sanitary Engineering. Systems of sewerage and methods of sewage purification. House drainage. Preparation required: 109. Second term. (2)

111. Thesis for Degree of C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

## SUMMER SCHOOLS IN CIVIL ENGINEERING.

Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1903 this work begins at 8 A. M. on June 18 and ends on July 11.

The work in Land Surveying is described under No. 88, on page 45. Students in Mining Engineering and Geology are required to take this work at the close of the Freshman year. The fee for other persons is $15.

The work in Topographic Surveying is described under No. 89 on page 45. Students in Civil and Mining Engineering and Geology are required to take this subject at the close of the Sophomore year. The fee for other persons is $15.

Strength of Materials. Twenty-four exercises in the classroom and six in the testing laboratory will be given in 1903, beginning at 9 A. M. on August 24 and ending on September 19. As this work is a rapid review of the subject, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 18, 1903. The fee is $20.

Hydraulics. Twenty-two exercises in the class room will be given in 1903, beginning at 11 A. M. on August 26 and ending on September 19. As this work is a rapid review of the subject, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 18, 1903. The fee is $15.

## MECHANICAL ENGINEERING.

PROFESSOR KLEIN,

MR. HECK, MR. TROWBRIDGE, MR. LEUTWILER, MR. STARKEY.

112. Drawing and Elements of Machine Design. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Second term. (3)

113. Constructive Elements of Machinery. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into the shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken

apart and again put together by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 206. For further details see special circulars of the M.E. and E.E. departments. Summer term, four weeks, beginning June 18, 1903.

114. Elements of Machine Design. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. First term. (3)

115. Boilers. Description of various types, and of details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller. First term. (1)

116. Steam Engine. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Holmes's Steam Engine. Second term. (4)

117. Steam Engine. Shorter course. Second term. (3)

118. Mechanical Techonology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is directed not only by these but also personally by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 18, 1903.

119. Mechanics of Machinery. Graphical statics of mechanisms. Determination of the efficiency of a machine and of the forces acting in every one of its pieces and parts. All the prob-

lems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term. (2)

120. Engineering Laboratory. Calibration and application of mechanical engineering measuring instruments. First term. (2)

121. Engineering Laboratory. Special course for students in Metallurgical, Mining, and Electrical Engineering, and Electrometallurgy. First term. (1)

122. Graphic Dynamics of a High Speed Engine. Complete force analysis, first by approximate practical methods and then by methods theoretically exact; action of steam forces, inertia resistances, etc. Preliminary design, consisting of a determination of the most important dimensions for an engine which is to work under given conditions. Second term. (3)

123. Engineering Laboratory. Work of 120 continued. Experiments on the flow of fluids and determination of the mechanical efficiencies of transmitting gear and of special machines with absorption and transmission dynamometers; testing of steam appliances. Second term. (1)

123A. Engineering Laboratory. Continuation of 121. Second term. (1)

124. Mechanics of Machinery. Machinery of Transmission. Weisbach-Herrmann series: Vol. III, Part 1, Section 1. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term. (3)

125. Summer School in Engineering Laboratory. Testing of air compressor, of a turbine, of water and electric motors, of hot-air and gas engines, of steam generators, and of simple and multiple-cylinder engines. Summer term, four weeks, beginning June 18, 1903.

126. Summer School in Marine Engineering. Constructive elements of ships. Visits of inspection and observation to the ships, shops, and yards of ship building establishments. Summer term, four weeks, beginning June 18, 1903.

127. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations

between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and vapors. Application of the results and of graphical methods to technical problems. First term. (3)

128. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. This work is mainly expended on the construction of centrodes, on inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including many forms of inertia resistances and external forces. First term. (5)

129. Design of Special Machinery. Each student is required to design some example of metal working machinery, as a lathe, plane, drill, or milling machine, so as to gain experience in proportioning parts both for strength and stiffness. This design is followed by one for a still more special machine, say, for performing some unusual operation. First term. (4)

130. Design of Special Machinery. Shorter course. First term. (2)

131. Engineering Laboratory. Work of 125 continued. Indicator practice: taking diagrams from the engines in the shops and power plants of the neighborhood—selected so as to represent as many types as possible—and working up the results. To this is added some dynamometer work and one boiler test. First term. (1)

132. Mechanics of Machinery. Cranes, Excavators and Pile Drivers. Chapters VI to VIII, inclusive, of Weisbach-Herrmann's Mechanics of Hoisting Machinery. These recitations are supplemented by visits of inspection. The Locomotive. The descriptive portion of the work is illustrated by drawings from good current practice and includes visits to the L. V. R. R. Repair Shops at South Easton. The mechanics of the locomotive is taken up as fully as time will permit; the subjects touched on are: General proportions, detailed analysis of the forces and inertia resistances, valve gear action, performance of the running gear on curves, etc. Extensive use is made of dia-

grams showing the fluctuations of the various periodic forces throughout a revolution. First term. (2)

133. Marine Engineering. Description of the various types of tubular and tubulous boilers, details, management, proportions, study of natural and forced draught and circulation; determination of radius of action of steamships. Text-book: Bertin and Robertson's Marine Boilers. First term. (1)

134. Marine Engineering. Ship Drawing. This work consists in laying down and fairing the lines of a vessel that has already been designed; then are made such general drawings as mid-ship section, out-board profile, in-board profile, and upper deck plans. First term. (3)

135. Marine Engineering. Ship calculations. Calculations relating to the forms, dimensions, and strength of ships, to their weight and centers of gravity, and to the steering gear. Text-book. Thearle's Theoretical Naval Architecture. Second term. (3)

136. Design of Special Machinery. This work is mainly a continuation of course 129. To complete this course there is required an original design for a hoist, or hydraulic press, or an automatic machine used for manufacturing some such article as wire nails. Second term. (5)

137. Design of Special Machinery. An abridgment of course 136. Second term. (2)

138. Engineering Laboratory. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term. (1)

139. Mechanics of Machinery. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrmann series. The class-room work is supplemented by suitably timed visits of inspection. Second term. (4)

140. Marine Engineering. Marine Engines. Seaton, Busley, and Sennet and Oram used as reference books. Advanced study of the Multiple-cylinder Engine; discussion of the strength and proportion of the moving parts; determination of the best expansion ratios, and the positions of the cylinders; valve-gears suited to marine types; equalization of the work on the several cranks and balancing of the moving parts. Second term. (2)

141. Marine Engineering. Ship resistance and propulsion. Estimate of the eddy, skin and wave resistances of a ship; the design of the propeller and the calculation of the power required to drive the ship. Text-book: Barnaby. Second term. (1)

142. Marine Engineering. Ship drawing. The methods of fastening together the different parts of a ship are first taken up and then drawings are made to show the general arrangement of the machinery and the disposition of the cargo. The course is completed by making the preliminary design or Sheer Draught for a new ship. Second term. (2)

143. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical engineering. Drawings and diagrams are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 113, 118, 125, and 126, also statement on page 69.

## METALLURGY AND MINERALOGY.

PROFESSOR FRAZIER,
ASSISTANT PROFESSOR RICHARDS,
MR. SULLIVAN, MR. HEWETT, MR. LANDIS.

144. Crystallography. Elementary course in Geometric Crystallography, with practical exercises in the determination of crystalline forms in models and actual crystals. First term. (2)

145. Mineralogy. Elementary course in physical, chemical, and descriptive Mineralogy, with practical exercises in the determination of about two hundred of the more common mineral species. Text-book: E. S. Dana's Text-book of Mineralogy. Second term. (3)

146. Mineralogy. Shorter course. Second term. (2)

(A deposit of $5 is required from each student taking courses 144, 145 and 146 to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it will not exceed $2 for each student.)

147. Blowpipe Analysis. An elementary course in blowpipe analysis considered as a method of qualitative chemical analysis. Illustrated lectures followed by practical testing for thirty-five bases and fifteen acids. Reference book: Plattner's Blowpipe Analysis, Latest English Edition, (1902). Second term. (1)

148. Blowpipe Analysis. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests

for determining minerals. Text-book: Plattner's Löthrohrprobirkunde. Sixth German edition, revised by Dr. F. Kolbeck. First term. (1)

149. Blowpipe Analysis. Laboratory course in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's Löthrohrprobirkunde. First term. (1)

(In each of the Blowpipe courses a deposit of $2 is required, of which, on an average, $1 is retained to cover cost of gas, chemicals, and specimens supplied.)

150. Drawing. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (3) Second term. (1)

151. Metallurgical Construction. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. First term. (3) For students in Metallurgical Engineering: First term. (1) Second term. (2)

152. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term. (2)

153. General Metallurgy and the Metallurgy of Iron. General Metallurgy: Metallurgical processes. Transmission of heat. Measurement of high temperatures. Furnaces. Fluxing. Fireproof materials. Principles of thermal chemistry. Combustion. Properties of natural and artificial fuels. Manufacture of gaseous fuels. The Siemens Furnace. Charcoal burning. Coking. The electric furnace. Reference books: Schnabel's Allgemeine Hüttenkunde, Roberts-Austen's Introduction to the Study of Metallurgy.

Metallurgy of Iron: Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. Remelting in the foundry. Pig washing. Puddling. The Bessemer process.

The open hearth process. Cementation. Manufacture of crucible steel. Direct processes. Methods of casting and forging. Reference books: Ledebur's Eisenhüttenkunde, Bauerman's Metallurgy of Iron. Second term. (5)

154. General Metallurgy and the Metallurgy of Iron. Shorter course. Reference book: Phillips-Bauerman's Elements of Metallurgy. Second term. (3)

155. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Mercury, and Aluminium: Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. First term. (4)

156. Metallurgical Laboratory. Calibration and use of pyrometers and calorimeters. Determination of melting and freezing points of metals and other metallurgical products. Study of cooling curves. Deposit, $10. Reference book: Howe's Metallurgical Laboratory Notes. Second term. (1)

157. Theory of Electrolysis. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Jones's Theories of Electrolytic Dissociation. First term. (1)

158. Electrometallurgy. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electrometallurgie, Blount's Practical Electrochemistry. Second term. (1)

159. Electrometallurgical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Deposit, $10. First and second terms. (1)

160. Thesis for the Degree of Met. E. Every student in Metallurgical Engineering is required to present a thesis on some topic connected with this subject.

161. Thesis for the Degree of El. Met. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 113 and 118, also statement on page 69.

## GEOLOGY AND THE NATURAL SCIENCES.

ASSISTANT PROFESSOR BARRELL, DR. HALL.

162. Megascopic Lithology. Determination of rocks which can safely be distinguished with the pocket lens, supplemented by ordinary chemical and blowpipe tests. Lectures and recitations followed by laboratory work on hand specimens. Preparation required: 145. First term. (2)

163. Petrology. The optical properties of minerals and their study with the petrological microscope. Recitations and laboratory work. Preparation required: 145. Second term. (2)

164. Petrology. The determination of rocks, their chemical and mineralogical composition and classification, their origin. Recitations and laboratory work with the microscope combined with a study of hand specimens. Preparation required: 163. First term. (2)

(A deposit of $5 is required from each student taking courses 163 and 164 to cover wear and tear, which with care need not exceed $2.)

165. Petrology. Advanced work in petrology consisting of the detailed study of some few phases of the subject. Second term. (2)

166. Geology. A course in structural, dynamic, and historical geology for those who desire to pursue the subject as a culture study, as well as for those who wish to obtain some knowledge of field geology without attaining the thoroughness necessary for the professional geologist or mining engineer. Recitations,

lectures illustrated by suites of fossils and stereopticon, field trips. This course includes a short review of those zoölogical and lithological principles necessary for a comprehension of the subject. Second term. (4)

167. Geology. Physiographic, structural, and dynamic geology. A course adapted to the needs of those who will use geology professionally. Lectures, recitations, assigned reading with trips in the field. Preparation required: 145. First term. (2)

168. Geology. A continuation of 167. Historical geology. Recitations and lectures illustrated with typical fossils. Preparation required: 178, 167. Second term. (2)

169. Geology. Invertebrate paleontology. Text-book and laboratory work in describing and identifying fossils. Preparation required: 168. First term. (4)

170. Economic Geology. Theories of the formation of deposits, their structure, geological horizons, and geographic distribution. Recitations and lectures illustrated by specimens of ores. Preparation required: 166 or 167. First term. (3)

171. Physiography. The classification of land forms; their stages of development; the factors determining them; the geographical distribution. Lectures, assigned reading, and field work. Preparation required: 166 or 167. Second term. (3)

172. Field Geology. Elementary field geology to accompany 164. Preparation required: 145, 178. First term. (3)

173. Field Geology. Field work to accompany the advanced petrology and historical geology. Second term. (3)

174. Geological Surveying. The identification of rocks and tracing of boundary planes under capping. The study of soils. Solution of problems in mapping. Forms of field notes. Recitations and lectures, field work, map drawing. Preparation required: 166 or 167. Second term. (2)

175. Pennsylvania Geology. This course is advanced work consisting in the study of certain problems well illustrated in this State, combining the reading of the literature with laboratory and field work. Preparation required: all of the previous geology. Second term. (3) or (5)

176. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and

references to text-books. Preparation (advantageous): 178. Second term. (2)

177. Plant Biology (Elements of Forestry). Recitations and lectures on the morphology, physiology, adaptation to environment, and classification of plants, especially trees; embodying the hygiene of forest and shade trees and the characteristics of useful timber woods. Second term. (1)

178. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions: life, protoplasm, the cell, etc., (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories: variation, heredity, evolution, etc. First term. (3)

179. Zoölogy. Lectures on the embryology and comparative anatomy of vertebrates, with a more extended discussion of biological theories. In the laboratory, after a brief study of vertebrate embryology, examples of the chief classes of vertebrates will be dissected with a view to following the evolution of organs. Preparation required: 178. Second term. (3)

180. Histology. Lectures, reading and laboratory work on the structure, growth, and differentiation of tissues. Preparation required: 179. First term. (2)

181. Thesis for the Degree of B.S. (Geol.). Every student in this course who is a candidate for this degree is required to present a thesis on some topic connected with Geology.

For Summer Schools see courses 88 and 89, also statement on page 69.

DR. ESTES, DR. HALL.

182. Hygiene. Lectures and recitations on Physiology and Health. First term. (2)

## MINING ENGINEERING.

ASSISTANT PROFESSOR ECKFELDT, MR. SULLIVAN.

183. Mining Engineering. Prospecting, valuation of property, boring, location of plant, timbering, shaft sinking. Lectures and recitations, references to text-books, monographs, and periodicals. Visits to mines. Preparation required: 166 or 167. Second term. (3)

184. Mining. Blasting, development of deposits, systems of winning underground and at daylight. Lectures and recitations. Second term. (2)

185. Mining Engineering. Haulage by track and wire, hoisting, drainage, ventilation, and lighting. Accidents, their cause, means of prevention, rescue, etc., police of mines, hygiene, rules, and laws. Lectures and recitations. First term. (3)

186. Mining Engineering. Theory of ore dressing. Physical principles on which it depends. Machines used in wet, dry, and magnetic methods, with the order in which they are arranged. The location of dressing works. The preparation of anthracite. Lectures, recitations, and visits to dressing works. Second term. (3)

187. Mine Surveying. Location of stations underground. Temporary and permanent side notes. Connecting surface and underground work through shafts or slopes. Mapping by coördinates. Care of maps, and variations due to temperature and moisture. Permanent forms of records. Detection of errors. Rectification of bore holes. Lectures and recitations, followed by practice with a mine corps and construction of map from notes of actual survey. Preparation required: 87, 88. Summer term, four weeks, beginning June 18, 1903.

188. Mechanical Drawing. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (3)

189. Mining Design. The design of parts of mining plant to meet assigned conditions, with detailed working drawings and estimates of cost. Each problem is accompanied by a memoir containing all calculations and descriptions, with which are bound tracings or blue prints of all drawings. Preparation required: 188. Second term. (2)

190. Thesis for the Degree of E.M. Candidates are required to present a thesis on some topic connected with this subject.

For Summer Schools see courses 88, 89, and 187, also statement on page 69.

## PHYSICS AND ELECTRICAL ENGINEERING.

### Physics.

PROFESSOR FRANKLIN, MR. MACNUTT, MR. CRAWFORD.

191. Elementary Physics. Mechanics and Heat. Lectures, recitations and problem work. Preparation required: 74 and 75. Second term. (2)

192. Elementary Physical Laboratory, accompanying 191. Fee $4. Second term. (1)

193. Elementary Physics. Electricity and Magnetism. Lectures, recitations, and problem work. Preparation required: 191, 192. First term. (3)

194. Elementary Physics. Mechanics, Heat, Electricity, and Magnetism. Lectures, recitations, and problem work. This study is offered to students in the School of General Literature. Preparation required: 74 and 75, or 76. First term. (3)

195. Elementary Physical Laboratory, accompanying 193 and 194. Fee $4. First term. (1)

196. Elementary Physics. Light and Sound. Lectures, recitations, and problem work. Preparation required: 193 or 194 and 195. Second term. (3)

197. Elementary Physical Laboratory, accompanying 196. Fee $4. Second term. (1)

198. Advanced Theory of Electricity and Magnetism. Electrical units, electrical measurements, inductance, the magnetism of iron, and electromagnetic theory. Lectures, recitations, and problem work. Preparation required: 80 and 191 to 197, inclusive. First term. (2)

199. Electrical Laboratory, accompanying 198 or 198 and 207 or 208. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests are given in order to facilitate the class work in 207 and 208. Fee $4, deposit $6. First term. (1)

200. Electrical Laboratory. Continuation of 199. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 210, 211, and 212. Fee $4, Deposit $6. Second term. (1) For students in the Course in Physics: First term. (1)

201. Theory of Light. This study is based upon Preston's Theory of Light, supplemented by Drude's Lehrbuch der Optik and by the reading of monographs on optics. First term. (5)

202. Theory of Heat. This study is based upon Clausius's Theory of Heat, supplemented by the reading of monographs on Physical Chemistry. Second term. (4)

203. Physical Laboratory. This course in laboratory work, offered during the Senior year to students taking the Course in Physics, consists of refined measurements in any branch of Physics at the option of the student, and it leads to the thesis work of the following term. First term. (2)

204. Physical Seminary. The study of current literature in Physics. The membership of the Physical Seminary includes the corps of instructors of the department of Physics and Electrical Engineering, together with Senior students in Physics. First and second terms. (2)

205. Thesis for the Degree of B.S. (in Physics). Each candidate for the degree of B. S. (in Physics) is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory or experimental research.

## Electrical Engineering.

PROFESSOR FRANKLIN, ASSISTANT PROFESSOR ESTY, MR. REGESTEIN.

206. Constructive Elements of Electrical Apparatus. Inspection and sketching of armatures, field magnets, commutators, base frames, bearings, brushes, brush holders, and rocker arms of dynamos and motors; of switch boards and switch board appliances; of lamp mechanisms, starting rheostats, regulators, cut-outs, meters, and line material; of telephone and telegraph material. Fee $2. This work is accompanied by Constructive Elements of Machinery, No. 113. Summer term, four weeks, beginning June 18, 1903.

207. Dynamos and Motors. Elementary electrodynamics with applications to direct current machinery. Principles of construction, operation, and characteristics of dynamo electric ma-

chinery with special reference to direct current types. Illustrative problems. Preparation required: 191 to 197 inclusive, and simultaneous work in 198 and 199. First term. (2)

208. Dynamos and Motors. This course is similar to the preceding but is especially adapted to those students who do not continue this subject in the Senior year. Special attention is given to the operation, regulation, management, and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 191 to 197 inclusive, and simultaneous work in 198 and 199. First term. (2)

209. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recitations, and problem work. Preparation required: 198, 199, 207, (or 208). Second term. (2)

210. Electrical Engineering. Continuation of 207. General survey of the more important industrial applications of electricity. Systems of generation, distribution, and transmission by direct and alternating currents; wiring; arc and incandescent lamps; feeder regulation. The latter part of the course is devoted to alternating current generators, motors, and transformers, being supplementary to the course in the Theory of Alternating Currents. Preparation required: 198, 207. Second term. (2)

211. Electrical Engineering. Continuation of 208. Similar in general scope to preceding. Particularly adapted to students who do not further specialize in the various technical applications above outlined. Preparation required: 198, 208. Second term. (2)

212. Theory of Alternating Currents. Continuation of 209. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 209, 210. First term. (2)

213. Dynamo-Electric Machinery. Continuation of 207. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions, methods of testing dynamo-electric machinery, transformers and transformer testing. Preparation required: 209, 210. First term. (3)

214. Electrical Design. Accompanying 213. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 209, 210. First term. (2)

215. Electric Lighting and Central Stations. Systems of electric lighting; principles and economics of location of site; selection, arrangement, and subdivision of generating units; general design of buildings and interior arrangements. Methods and economics of distribution of electrical energy for light and power by direct and alternating currents; regulation and operation of supply circuits. Manufacture, care, and use of arc and incandescent lamps; insurance rules and regulations; commercial photometry; visits of inspection to neighboring plants. Preparation required: 209, 210. First term. (2)

216. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; reports on thesis work; new inventions and discoveries critically reviewed. Indexing of periodical literature. Preparation required: 209, 210. First term. (1)

217. Telegraphs and Telephones. Quadruplex telegraphy; synchronous multiplex telegraphy; printing telegraph; submarine telegraphy; wireless telegraphy; telephone systems and appliances. Preparation required: 198, 199. First term. (2)

218. Dynamo Laboratory. Direct current. Experimental studies and tests of direct current dynamos, motors, and appliances. Preparation required: 200, 207. Fee, $6, deposit $4. First term. (2)

219. Theory of Alternating Currents. Continuation of 212. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 212, 213, 214, 215, 218. Second term. (2)

220. Electrical Design. Continuation of 214. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters and leading up to original designing; drafting. Preparation required: 212, 213, 214. Second term. (2)

221. Electric Power Transmission and Traction. The long distance transmission of power by electricity for use in lighting, traction, mining, and manufacturing work. Design, construction, maintenance and protection of lines. Receiving systems. Electrical distribution, principles of construction, and testing of electric traction systems. Applications to surface and ele-

vated electric roads and to mine haulage. Testing of light and power plants; visits of inspection to neighboring plants. Preparation required: 212, 213, 215. Second term. (2)

222. Electrical Engineering Seminary. Continuation of 216. Preparation required: 212, 213, 214, 215, 216. Second term. (1)

223. Dynamo Laboratory. Alternating current. Experimental studies and tests of alternating current dynamos, synchronous motors, induction motors, rotary converters, transformers, and appliances. Preparation required: 212, 218. Fee, $6, deposit $4. Second term. (2)

224. Electrotechnology. This study includes a review of the principles of electricity and magnetism in their bearing upon dynamo electric machinery, the elementary theory of dynamos and motors, and the study of the operation, regulation, management, and methods of testing dynamos and motors. Illustrative problems. Preparation required: 191 to 197, inclusive. First term. (2)

225. Electrotechnology, (Electric Railways). Continuation of 224. General survey of the more important industrial applications of electricity. This study is specially adapted to the needs of Civil and Mining engineers; particular attention is given to the generation, distribution, and utilization of electricity for lighting and power. Preparation required: 224. Second term. (2)

226. Electrical Laboratory, accompanying 157. Experimental studies in electrolysis. Measurements of resistances of electrolytes, applications of Faraday's laws of electrolysis, studies of electrolytic polarization, determinations of critical voltages of decomposition, tests of primary batteries and storage batteries, and tests of commercial types of electrolytic cells. Fee, $4, deposit $6. First term. (1)

227. Electrical Laboratory, optional, accompanying 225. Electrical measurements and simple dynamo and motor testing. Fee $4, deposit $6. Second term. (1)

228. Thesis for the Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing.

For Summer Schools see courses 113, 206, and 118, also statement on page 69.

## CHEMISTRY.

PROFESSOR CHANDLER,

MR. SPANUTIUS, DR. SCHOBER, DR. ULLMANN, MR. DIEFENDERFER.

229. General Introduction to Theoretical Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, lantern pictures, and specimens from the museum. Note-books on the lectures required. Reference book: Remsen's Inorganic Chemistry, Advanced Course. First term. (2)

230. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. First term. (2)

231. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures. Text-book: Prescott and Johnson's Qualitative Chemical Analysis. Second term. (6)

232. Qualitative Analysis. Shorter courses. Second term. (3), (2), or (1)

233. Stoichiometry. Chemical problems, and reactions. Text-book: Thorpe and Tait's Chemical Calculations. Second term. (2)

234. Chemical Philosophy. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, solutions, electrolysis, thermo-chemistry, etc. Text-books: Tilden's Chemical Philosophy; Whitley's Chemical Calculations; Remsen's Inorganic Chemistry, Advanced Course. First term. (3)

235. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds. Text-book: Fresenius's Quantitative Analysis, edited by Allen and Johnson. First term. (6)

236. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term. (3)

237. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 235. First term. (1)

238. Quantitative Analysis. Continuation of course 236. Second term. (4)

239. Quantitative Analysis. Continuation of course 235. Analysis of minerals, ores, slags, alloys, etc. Text-books: Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term. (6)

240. Quantitative Analysis. Shorter course. Second term. (3) or (2)

241. Quantitative Analysis Conference. Discussions concerning laboratory work of course 239. Second term. (1)

242. Theoretical Chemistry. The elements and their compounds. Text-book: Remsen's Chemistry, Advanced Course. Second term. (3)

243. Toxicology. Lectures illustrated by experiments and by a large collection of specimens of poisons from the museum of chemistry, and supplemented by a short course of laboratory work on some of the common poisons. First term. (2)

244. Quantitative Analysis. Continuation of course 239. Ores and alloys; complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Fresenius's Quantitative Analysis edited by Allen and Johnson, Hempel's Gas Analysis. First term. (6)

245. Quantitative Analysis. Shorter course. Second term. (3) or (2)

246. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 244. First term. (1)

247. Quantitative Analysis. Continuation of course 238. Analysis of ores and metallurgical products, and gas analysis. First term. (3) or (2)

248. Organic Chemistry. Illustrated lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of converting compounds of one class into those of another. Text-books: Remsen's Introduction to the Study of the Carbon Compounds; Richter's Organic Chemistry, translated by Smith. First term. (5)

249. Organic Chemistry. Practical laboratory work. Determination of specific gravities, melting points, boiling points, vapor densities; also of chlorine, bromine, iodine, and sulphur of organic substances. Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds. Text-books: Gattermann's Practical Methods of Organic Chemistry, translated by Schober; Levy's Anleitung zur Darstellung Organischer Präparate. Second term. (6)

250. Organic Chemistry Conference. Discussions concerning the laboratory work of course 249. Second term. (1)

251. Industrial Chemistry. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; manufacture of coal gas; fermentation; bleaching. First term. (3)

252. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes practiced in the United States Mint. Text-book: Rickett's and Miller's Notes on Assaying. First term. (3)

253. Microscopy. Instruction in the use of the microscope. Text-book: Bausch's Manipulation of the Microscope. First term. (2)

254. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. Second term. (3)

255. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term. (3)

256. Industrial Analysis Conference. Discussion concerning the laboratory work of course 255. Second term. (1)

257. Agricultural Chemistry. The application of chemistry to problems in agriculture. Laboratory work. Second term. (1)

258. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other subjects connected with this branch of the science. Second term. (1)

259. Physical Chemistry. Lectures and recitations. Text-book: Jones's Physical Chemistry. First term. (1)

260. Physical Chemistry. Laboratory work. Determination of molecular weights and physico-chemical measurements. First term. (1)

261. Electrochemistry. Lectures and recitations. Second term. (1)

262. Electrochemistry. Laboratory work. Preparation of chemicals by electrolysis. Electrochemical measurements. Second term. (1)

263. Technical German. Recitations based on German texts dealing with chemical subjects. Text book for 1903: Levy's Anleitung zur Darstellung Organischer Präparate. Second term. (1)

264. Theses for the Degrees of A.C. and Ch.E. Preparation of a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the library, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Five dollars each in courses 260 and 262; ten dollars each in courses 230, 253, 255, and 257; fifteen dollars in course 258; twenty dollars each in courses 247 and 251; twenty-five dollars each in courses 232, 236, 240, and 245; thirty dollars each in courses 231, 235, 238, 239, 244, and 252; thirty-five dollars in course 249.

Summer Schools. Courses in Qualitative and Quantitative Analysis, Assaying, and Microscopy begin June 18, 1903, and continue five weeks. They are open to all persons prepared to take them.

## SUMMER SCHOOLS.

The summer schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, Metallurgical Engineering, Electrometallurgy, and Chemical Engineering, and in Mechanical Technology at the end of the Sophomore year in these courses, the summer school in Topographic Surveying in the courses of Civil Engineering, Mining Engineering, and Geology at the end of the Sophomore year, the summer school in Mine Surveying in the courses of Mining Engineering and Geology at the end of the Junior year, and also the summer school in Engineering Laboratory in the course of Chemical Engineering at the end of the Junior year are required studies and are therefore to be regarded as the summer terms of the courses. In the course of Mechanical Engineering the summer schools in Engineering Laboratory and in Marine Engineering, which are held at the end of the Junior year, are required courses in their respective options.

Likewise the instruction in Land Surveying at the end of the Freshman year is required of the students in the courses of Mining Engineering and Geology, but is optional for the students in the course in Civil Engineering. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering.

In addition to this required summer work, there are also summer schools in Mathematics, Strength of Materials, Hydraulics, Chemistry, Physics, German, and French designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned summer schools, with the exception of the summer schools in Chemistry, begin in August. A special circular giving details, fees required, etc., will be sent to those applying for it.

## PHYSICAL CULTURE.

All students on entering the University are required to undergo a physical examination and special exercises are prescribed for each student. During the Freshman year gymnasium exercise is required twice a week, and there is a general dumb-bell drill for students of all classes four times a week, at which attendance is optional. All exercises are under the direction and supervision of a skilled instructor and are designed to promote the harmonious and symmetrical development of the individual student.

# SCHOOL OF GENERAL LITERATURE.

## PURPOSE AND METHOD.

The purpose of this department of the University is to provide systematic courses of study which shall meet the requirements of a liberal education and lay the foundation for the study of the several professions. The University desires that these courses be not merely academic in character, but of practical worth, and sustain a definite relation to the sphere of life which each student has before him. That the culture-purpose which is the basis of them may not be ignored, a limited amount of work in subjects of a literary, philosophic, and scientific character, which are both valuable as instruments of culture and necessary preliminaries of all higher study, is required of every student. Beyond that the work is elective. Until the second term of the Sophomore year the studies are prescribed; from then on they become increasingly subject to the student's own choice.

In pursuance of the policy of making these courses practical and directly preparatory to each student's life-work, large freedom is allowed in the choice of electives. Any study which is taught in the University may be taken, subject to the qualification and purpose of the student. Students are counseled to select their work systematically with reference to some definite end. In this they receive the assistance and coöperation of the Faculty, under the oversight of one of whose members each student arranges his course.

## ADMISSION, CLASSIFICATION, DEGREE.

The requirements for admission are stated in detail on pages 21 to 23. On the basis of these the studies of the School of General Literature are classified, for the sake of convenience, into the Classical and Latin-Scientific courses. Greek is required in the Classical course; its place is taken in the Latin-Scientific course by modern languages, mathematics, and science. Except for such separation as grows necessarily out of this difference in the qualification for admission the two courses are parallel.

The course of study extends over four years. Students, however, who can do so, are permitted to pass off required work in advance and to fill up the time thus left free with other advanced studies with a view to completing the requirements for graduation in a shorter time.

The degree of Bachelor of Arts is bestowed upon all graduates of the School of General Literature.

### PREPARATION FOR LAW, MEDICINE, TEACHING, ETC.

Young men who have in view the profession of law, medicine, theology, teaching, or journalism, will find in the courses of study which this department of the University offers that general and special preliminary training which is more and more becoming essential. For the better preparation of such men for entrance upon their professional studies the University is constantly enlarging its curriculum as need determines.

### COMBINATION OF LITERARY AND TECHNICAL STUDIES.

The University considers it desirable that young men who expect to follow an engineering profession receive a broader education than is possible in an engineering course of four years' duration, which must of necessity be occupied almost exclusively by subjects of a technical and professional character. A good many subjects which are essential to an engineering curriculum are proper also to academic courses. But an academic student who subsequently proceeds to engineering study often finds that his training in these common branches has been inadequate to the successful application of them to engineering work. Time can be saved and more efficient preparation given when they are under one common guidance. The University is able by systematically combining the studies of its several engineering schools with the studies peculiar to the School of General Literature to offer courses of six years' duration which lead to the degree of Bachelor of Arts and an engineering degree, and in which neither the purpose nor the efficiency of either course is sacrificed. Students in these courses receive the Bachelor's degree at the end of four years, the engineering degree upon the completion of the engineering studies.

### SCHEDULE OF STUDIES.

The following table of studies exhibits the required and the ordinary elective studies of the School of General Literature. Those peculiarly technical studies which enter into the combined courses are not here printed in the lists of electives. More detailed information regarding these combined courses and the systematic arrangement of work preparatory to professional study, to teaching, etc., will be found in the circular of the School of General Literature, copies of which may be had by addressing the Registrar of the University.

## THE CLASSICAL COURSE.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Alg. and Solid Geom., (4) | 74, 76 | Trigonometry, (3) | 77 |
| Greek, (4) | 25 | Greek, (4) | 26 |
| Latin, (3) | 16 | Latin, (5) | 17 |
| German, (2) | 45 | German, (2) | 46 |
| Hygiene, (2) | 182 | English, (2) | 59, 62 |
| English, (3) | 57, 58, 62 | Public Speaking, (1) | 72 |

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Greek, (3) | 27 | Greek, (3) | 28 |
| Latin, (3) | 18 | Latin, (3) | 19 |
| German, (3) | 47 | German, (3) | 48 |
| French, (2) | 35 | French, (2) | 36 |
| English, (2) | 60, 63 | English, (2) | 61, 63 |
| Physics, (3) | 194 | (*Elective, four hours*) | |
| Physical Laboratory, (1) | 195 | Greek, (2) | 29 |
| Public Speaking, (1) | 73 | Latin, (2) | 20 |
| | | History, (2) | 13 |
| | | Projection Drawing, (3) | 85 |
| | | Land Surveying, (1) | 87 |
| | | Elementary Mechanics, (5) | 78 |
| | | Physics, (3) | 196 |
| | | Physical Laboratory, (1) | 197 |
| | | Botany, (2) | 176 |
| | | Forestry, (1) | 177 |

### JUNIOR YEAR.

| FIRST TERM (*Required*). | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Psychology, (2) | 1 | Psychology, (2) | 2 |
| Economics, (2) | 6 | Economics, (2) | 7 |
| English, (1) | 64 | European History, (1) | 12 |
| European History, (1) | 12 | (*Elective, twelve hours*) | |
| Chemistry, (2) | 229 | Greek, (3) | 31 |
| Chemical Laboratory, (2) | 230 | Latin, (3) | 22 |
| (*Elective, seven hours*) | | French, (3) | 38 |
| Greek, (3) | 30 | German, (2) | 50 |
| Latin, (3) | 21 | English, (3) | 67 |
| French, (3) | 37 | History, (2) | 15 |
| German, (2) | 49 | Calculus, (5) | 80 |
| English, (3) | 66 | Mineralogy, (3) | 145 |
| History, (2) | 14 | Blowpipe Analysis, (1) | 147 |
| Analytic Geometry, (5) | 79 | Qualitative Analysis, (3) | 232 |
| Elec. and Magnetism, (2) | 198 | *Surveying, (3) | 88 |
| Electrical Laboratory, (1) | 199 | Zoölogy, (3) | 179 |
| Crystallography, (2) | 144 | | |
| Biology, (3) | 178 | | |

The figures in parentheses indicate the number of exercises per week.
* May be taken in the summer term after Sophomore year.

### SENIOR YEAR.

FIRST TERM (*Required*).

| | |
|---|---|
| History of Philosophy, (2) | 3 |
| (*Elective, fifteen hours*) | |
| Greek, (3) | 32 |
| Latin, (3) | 23 |
| German, (2) | 51 |
| French, (2) | 39 |
| Spanish, (2) | 55 |
| English, (3) | 68 |
| Economics, (2) | 8 |
| Politics, (2) | 10 |
| Analytic Mechanics, (2) | 81 |
| Descriptive Astronomy, (3) | 82 |
| Theory of Light, (5) | 201 |
| Architecture, (2) | 104 |
| Quantitative Analysis, (3) | 236 |
| Blowpipe Analysis, (1) | 148 |
| Lithology, (2) | 162 |
| Histology, (2) | 180 |

SECOND TERM (*Required*).

| | |
|---|---|
| Hist. of Mod. Philosophy, (2) | 4 |
| Philosophy of Religion, (1) | 5 |
| Thesis, (3) | |
| (*Elective, eleven hours*) | |
| Greek, (3) | 33 or 34 |
| Latin, (3) | 24 |
| German, (2) | 52 or 54 |
| French, (2) | 40 |
| Spanish, (2) | 56 |
| English, (3) | 69 or 70 |
| Economics, (2) | 9 |
| Politics, (2) | 11 |
| Practical Astronomy, (2) | 83 |
| Theory of Heat, (4) | 202 |
| Quantitative Analysis, (4) | 238 |
| Geology, (4) | 166 |

## THE LATIN-SCIENTIFIC COURSE.

### FRESHMAN YEAR.

FIRST TERM.

| | |
|---|---|
| Algebra and Trig., (4) | 74, 75 |
| Latin, (4) | 16 |
| German, (3) *or* French, (3) | 47 / 37 |
| Freehand Drawing, (2) | 84 |
| Hygiene, (2) | 182 |
| English, (3) | 57, 58, 62 |

SECOND TERM.

| | |
|---|---|
| Elementary Mechanics, (5) | 78 |
| Latin, (5) | 17 |
| German, (3) *or* French, (3) | 48 / 38 |
| English, (2) | 59, 62 |
| Land Surveying, (1) | 87 |
| Public Speaking, (1) | 72 |

### SOPHOMORE YEAR.

FIRST TERM.

| | |
|---|---|
| Latin, (3) | 18 |
| German, (2) | 45 or 49 |
| French, (2) | 35 or 39 |
| English, (2) | 60, 63 |
| Physics, (3) | 194 |
| Physical Laboratory, (1) | 195 |
| Chemistry, (2) | 229 |
| Chemical Laboratory, (2) | 230 |
| Public Speaking, (1) | 73 |

SECOND TERM (*Required*).

| | |
|---|---|
| Latin, (3) | 19 |
| German, (2) | 46 or 50 |
| French, (2) | 36 or 40 |
| English, (2) | 61, 63 |
| Physics, (3) | 196 |
| Physical Laboratory, (1) | 197 |
| (*Elective, four hours*) | |
| Latin, (2) | 20 |
| History, (2) | 13 |
| Projection Drawing, (3) | 85 |
| Qualitative Analysis, (3) | 232 |
| Stoichiometry, (2) | 233 |
| Botany, (2) | 176 |
| Forestry, (1) | 177 |

The figures in parentheses indicate the number of exercises per week.

## JUNIOR YEAR.

| FIRST TERM (*Required*). | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Psychology, (2) | 1 | Psychology, (2) | 2 |
| Economics, (2) | 6 | Economics, (2) | 7 |
| French, (3) *or* German, (3) | 37 47 | French, (3) *or* German, (3) | 38 48 |
| English, (1) | 64 | European History, (1) | 12 |
| European History, (1) | 12 | (*Elective, nine hours*) | |
| (*Elective, eight hours*) | | Latin, (3) | 22 |
| Latin, (3) | 21 | German, (2) *or* French, (2) | 52 or 54 42 |
| German, (2) *or* French, (2) | 51 41 | English, (3) | 67 |
| English, (3) | 66 | History, (2) | 15 |
| History, (2) | 14 | Calculus, (5) | 80 |
| Analytic Geometry, (5) | 79 | Mineralogy, (3) | 145 |
| Elec. and Magnetism, (2) | 198 | Blowpipe Analysis, (1) | 147 |
| Electrical Laboratory, (1) | 199 | Quantitative Analysis, (4) | 238 |
| Crystallography, (2) | 144 | Alternating Currents, (2) | 209 |
| Quantitative Analysis, (3) | 236 | *Surveying (3) | 88 |
| Biology, (3) | 178 | Zoölogy, (3) | 179 |

## SENIOR YEAR.

| FIRST TERM (*Required*). | | SECOND TERM (*Required*). | |
|---|---|---|---|
| History of Philosophy, (2) | 3 | Hist. of Mod. Philosophy, (2) | 4 |
| (*Elective, fifteen hours*) | | Philosophy of Religion, (1) | 5 |
| Latin, (3) | 23 | Thesis, (3) | |
| French, (2) | 39 or 43 | (*Elective, eleven hours*) | |
| German, (2) | 49 or 53 | Latin, (3) | 24 |
| Spanish, (2) | 55 | French, (2) | 40 or 44 |
| English, (3) | 68 | German, (2) | 50 or 54 |
| Economics, (2) | 8 | Spanish, (2) | 56 |
| Politics, (2) | 10 | English, (3) | 69 or 70 |
| Analytic Mechanics, (2) | 81 | Economics, (2) | 9 |
| Architecture, (2) | 104 | Politics, (2) | 11 |
| Descriptive Astronomy, (3) | 82 | Practical Astronomy, (2) | 83 |
| Alternating Currents, (2) | 212 | Geology, (4) | 166 |
| Histology, (2) | 180 | Alternating Currents, (2) | 219 |
| Theory of Light, (5) | 201 | Theory of Heat, (4) | 202 |

The figures in parentheses indicate the number of exercises per week.

* May be taken in the summer term after Sophomore year.

## THE COURSE IN CIVIL ENGINEERING.

The requirements for admission to this course may be found on pages 23 to 25. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The program of studies of this course, given on page 79, shows the subjects required to be completed by candidates for the degree of Civil Engineer. The numbers following the subjects refer to the detailed descriptions on pages 36 to 69. The figures in parentheses indicate the number of exercises per week.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term civil engineering. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, freehand sketching in the first term and instrumental work in the second. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed and the technical work of civil engineering is begun by practical problems in Structural Drawing and by lectures on Construction. During the Junior and Senior years the time is mostly devoted to professional studies, but there are lectures on Economics and on Philosophy, and the student has an opportunity of electing subjects which lead on the one hand in the direction of architecture and on the other hand in the direction of mining and metallurgy. The theory of Land Surveying is begun in the Sophomore year, and is accompanied by field work and map drawing. Those who desire to take this subject in the vacation at the end of the Freshman year will be allowed to do so under the regulations stated on page 49. All the work in Topographic Surveying is done

in four weeks following the end of the Sophomore year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying tools enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction are grouped the topics of masonry, foundations, roads and pavements, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is mainly by lectures, with references to standard books and engineering journals. Many visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is begun in the first term of the Junior year and later the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, designs and working drawings are prepared by each student for both highway and railroad bridges. These drawings are made, dimensioned, and checked in the same manner as in the drafting room of a bridge company, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures also receives detailed attention. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of collecting, purifying, and distributing water are explained and compared; house drainage, the design of sewerage systems, and

the disposal of sewage also receive attention. Visits of inspection to water works are made and detailed reports upon them are prepared. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in Hydraulic and Sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Mechanics of Machinery treats of cranes, elevators, and locomotives, and that of Electric Railroads of the equipment and operation of trolley roads.

During the Junior and Senior years there are thirteen subjects offered, of which six are to be elected by the student. Those intending to work in the line of architectural engineering will naturally select Architecture, Heating and Ventilation, and Architectural Design, while those wishing to work in the direction of mining and metallurgy will select Mineralogy, Lithology, Geology, and the Metallurgy of Iron. Other elective subjects are Steam Engine, Railroad Construction, and an advanced course in Materials of Construction, with special reference to inspection and testing. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs or laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who select theses on investigations on the properties of materials. During the past year a 100,000-pound Riehlé testing machine, equipped with autographic recording and automatic speed apparatus, has been installed in the laboratory.

The student who completes this course will receive the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 28.

## THE COURSE IN CIVIL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (4) | 229, 230 | Physics, (2) | 191 |
| German, (3) *or* | 47 | Physical Laboratory, (1) | 192 |
| French, (3) | 37 | Projection Drawing, (3) | 85 |
| Freehand Drawing, (2) | 84 | Forestry, (1) | 177 |
| Hygiene, (2) | 182 | German, (3) *or* | 48 |
| English, (3) | 57, 58, 62 | French, (3) | 38 |
| | | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

SUMMER TERM.

Land Surveying, (optional,) 87, 88.

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 194 | Physical Laboratory, (1) | 197 |
| Construction, (2) | 92 | Construction, (2) | 93 |
| Perspective, (2) | 103 | Land Surveying, theory, (1) | 87 |
| Structural Drawing, (2) | 86 | Land Survey'g, practice, (3) | 88 |
| English, (2) | 60, 63 | English, (2) | 61, 63 |
| Public Speaking, (1) | 73 | | |

SUMMER TERM.

Topographic Surveying, 89.

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Descriptive Astronomy, (3) | 82 | Railroad Surveying, (5) | 90 |
| Strength of Materials, (4) | 96 | Hydraulics, (3) | 108 |
| Construction, (3) | 94 | Roofs and Bridges, (4) | 100 |
| Graphic Statics, (4) | 99 | Economics, (1) | 7 |
| Economics, (1) | 6 | Heating and Vent., (2) *or* | 107 |
| Architecture, (2) *or* | 104 | Mineralogy, (2) | 146 |
| Crystallography, (2) | 144 | Railroads, (2) *or* | 95 |
| | | Practical Astronomy, (2) | 83 |

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Geodetic Surveying, (3) | 91 | Bridges, (2) | 102 |
| Bridge Design, (5) | 101 | Electric Railways, (2) | 225 |
| Sanitary Engineering, (3) | 109 | Philosophy of Religion, (1) | 5 |
| Mech. of Machinery, (2) | 119 | Sanitary Engineering, (2) | 110 |
| Electrotechnology, (2) | 224 | Geology, (4) *or* | 166 |
| Materials, (2) *or* | 97 | Steam Engine, (4) | 116 |
| Lithology, (2) *or* | 162 | Architectural Design, (3) *or* | 106 |
| Architecture, (2) | 105 | Metallurgy, (3) | 154 |
| | | Thesis, (3) | 111 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurement of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a summer term, lasting four weeks, which is held at the close of the second term of Freshman year.

In this same summer term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of Physics and to the special course in Electrical Engineering which they pursue later on.

A second summer term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing the student with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery.

During the course there are frequent visits of inspection to the Bethlehem Steel Company to the Lehigh Valley R. R. shops at Easton, and to other engineering works both in and out of town, with special reference to such subjects as prime movers, machinery for lifting, handling, and transporting, and machinery for changing the form and size of materials.

The instruction in Machine Design begins with the second term of the Freshman year and is continued throughout the course. At first tracings and blue-prints of good examples of drawings of machinery are made. A thorough drill in projection drawing follows; in this work freehand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such draw-

ings, and general views of lathes, planers, drills, and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates, and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. In the case of these machines and of the engine the general plan of arrangement will be given to the students in the form of rough sketches, photographs, or woodcuts. In the last term the students are expected to make original designs for simple machinery, the object of which has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency. Instruction is also given in locating and remedying the common faults of dynamos and motors.

The course in Engineering Laboratory consists at first in the calibration of mechanical engineering measuring instruments, then in experiments on the flow of fluids, then in the determination of the mechanical efficiencies of transmitting gear and of special machines. This is followed by a summer term of four weeks devoted entirely to experimental work, which includes the testing of an air compressor, of turbines, of

water and electric motors, of hot air and gas engines, of steam generators and of simple and multiple-cylinder engines. Finally the students are required to undertake complete tests of some of the power plants of the vicinity. For this course of work there is available the newly constructed Steam Engineering Laboratory and the additional space reserved in Williams Hall for the experimental apparatus, machinery, and motors presented by Mr. Warren A. Wilbur to the department of Mechanical Engineering.

In the Junior and Senior years Marine Engineering is offered as an optional course to the students of this department. This course concerns itself mainly with the Engine or Power Department of Shipbuilding, and is treated as an advanced portion of Steam Engineering and Applied Mechanics. The available time is, therefore, principally devoted to Marine Boilers and their accessories, to Marine Engines, both main and auxiliary, and to the Theory of the Screw Propeller. The time remaining is given to the Hull Department of Shipbuilding by the study of the Mechanics of Flotation and Stability, and to the Resistance and Steering of Ships. At the end of the Junior year there is a summer term of four weeks devoted to inspection and study of the ships, shops, and yards of shipbuilding establishments.

All the students in this course are required to study both German and French.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

## THE COURSE IN MECHANICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Draw'g and Mach. Des., (3) | 112 |
| Freehand Drawing, (2) | 84 | German, (3) *or* French, (3) | 48 / 38 |
| Hygiene, (2) | 182 | English, (2) | 59, 62 |
| English, (3) | 57, 58, 62 | Public Speaking, (1) | 72 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 113, 206.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Machine Design, (3) | 114 | Steam Engine, (4) | 116 |
| Boilers, (1) | 115 | French, (2) *or* | 36 |
| French, (2) *or* | 35 | German, (2) | 46 |
| German, (2) | 45 | English, (2) | 61, 63 |
| English, (2) | 60, 63 | | |
| Public Speaking, (1) | 73 | | |

SUMMER TERM.

Mechanical Technology, 118.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 81 | Graphic Dynamics, (3) | 122 |
| Mech. of Machinery, (2) | 119 | Mech. of Machinery, (3) | 124 |
| Dynamos and Motors, (2) | 208 | Hydraulics, (3) | 108 |
| Elec. and Magnetism, (2) | 198 | Electrical Laboratory, (1) | 200 |
| Electrical Laboratory, (1) | 199 | Engineer'g Laboratory, (1) | 123 |
| Engineer'g Laboratory, (2) | 120 | Economics, (1) | 7 |
| Strength of Materials, (4) | 96 | French, (2) *or* | 38 |
| Economics, (1) | 6 | German, (2) | 48 |
| French, (2) *or* | 37 | OPTIONS. | |
| German, (2) | 47 | Electrical Eng., (2) | 211 |
| | | Alt. Currents, (2) | 209 |
| | | *or* | |
| | | Marine Engineer'g, (4) | 135, 141 |

SUMMER TERM.

Engineering Laboratory, 125, *or* Constructive Elements of Ships, 126 (corresponding to preceding options).

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Thermodynamics, (3) | 127 | Machine Design, (5) | 136 |
| Kinematics of Mach., (5) | 128 | Engineer'g Laboratory, (1) | 138 |
| Machine Design, (4) | 129 | Metallurgy, (3) | 154 |
| Engineer'g Laboratory, (1) | 131 | Philosophy of Religion, (1) | 5 |
| OPTIONS. | | Thesis, (3) | 143 |
| Graphic Statics, (2) | 98 | OPTIONS. | |
| Mech. of Mach., (2) | 132 | Mech. of Machinery, (4) | 139 |
| *or* | | *or* | |
| Marine Engineering, (1) | 133 | Marine Engineer'g, (4) | 140, 142 |
| Marine Engineering, (3) | 134 | | |

**A special option in Electrical Engineering may be arranged.**

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN METALLURGICAL ENGINEERING.

This course is designed to prepare the student for practice in the field of Metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, including work in the testing laboratory, Graphic Statics, as applied to roof trusses and girders, Mechanical Technology, Steam Boilers, The Steam Engine, The Mechanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., The Measurement of Power, Hydraulics, including hydraulic motors and Electrotechnology, including the theory of electric motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses in Mineralogy and Blowpipe Analysis involve practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. The mineralogical laboratory affords facilities for advanced courses in geometric and physical crystallography which are not included in the ordinary curriculum. An elective course in Quantitative Blowpipe Analysis is open to a limited number of students.

A course in Lithology gives practice in the identification of rocks and is followed by courses in Historic, Dynamic and Economic Geology.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparation of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes of an assigned portion of the plant. From these working drawings are made and memoirs written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout a year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them.

The vicinity of the works of the Bethlehem Steel Company and of the New Jersey Zinc Company, and the kindness of their officers, give opportunities for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and of zinc. Occasional visits of inspection are made to more distant works.

Graduates in this course receive the degree of Metallurgical Engineer (Met.E.).

## THE COURSE IN METALLURGICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Qualitative Analysis, (3) | 232 |
| | | Stoichiometry, (2) | 233 |
| Freehand Drawing, (2) | 84 | German, (3) *or* French, (3) | 48 / 38 |
| Hygiene, (2) | 182 | English, (2) | 59, 62 |
| English, (3) | 57, 58, 62 | Public Speaking, (1) | 72 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 113, 206.

### SOPHOMORE YEAR

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Drawing, (3) | 150 | Blowpipe Analysis, (1) | 147 |
| Metallurgical Constr., (1) | 151 | Mineralogy, (3) | 145 |
| Crystallography, (2) | 144 | Metallurgical Constr., (2) | 151 |
| English, (2) | 60, 63 | Drawing, (1) | 150 |
| Public Speaking, (1) | 73 | English, (2) | 61, 63 |

SUMMER TERM.

Mechanical Technology, 118.

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Strength of Materials, (4) | 96 | Metallurgy, (5) | 153 |
| Boilers, (1) | 115 | Steam Engine, (4) | 116 |
| Lithology, (2) | 162 | Geology, (4) | 166 |
| Blowpipe Analysis, (1) | 148 | Quantitative Analysis, (4) | 238 |
| Chemical Philosophy, (3) | 234 | Economics, (1) | 7 |
| Quantitative Analysis, (3) | 236 | | |
| Economics, (1) | 6 | | |
| English, (1) | 65 | | |

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 155 | Mech. of Machinery, (4) | 139 |
| Assaying, (3) | 252 | Metallurgical Design, (2) | 152 |
| Quantitative Analysis, (3) | 247 | Metallurgical Lab., (1) | 156 |
| Electrotechnology, (2) | 224 | Ore Dressing, (3) | 186 |
| Graphic Statics, (2) | 98 | Hydraulics, (3) | 108 |
| Economic Geology, (3) | 170 | Engineering Lab., (1) | 123A |
| Engineer'g Laboratory, (1) | 121 | Philosophy of Religion, (1) | 5 |
| | | Thesis, (3) | 160 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN ELECTROMETALLURGY.

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first two years the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, mineralogy, drawing, and modern languages. In the third and fourth years this course agrees with the Metallurgical Engineering course in the inclusion of chemical analysis, chemical philosophy, metallurgy, ore dressing, boilers, steam engine, measurement of power, and the general culture studies; it differs from it by devoting less time to assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current resistance, electromotive force, inductive capacity, magnetic testing of iron, etc.; Theory of Direct and Alternating-Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrolysis and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

Graduates in this course receive the degree of Electrometallurgist (El.Met.).

## THE COURSE IN ELECTROMETALLURGY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Qualitative Analysis, (3) | 232 |
| Freehand Drawing, (2) | 84 | Stoichiometry, (2) | 233 |
| Hygiene, (2) | 182 | German, (3) *or* French, (3) | 48 / 38 |
| English, (3) | 57, 58, 62 | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 113, 206.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Drawing, (3) | 150 | Blowpipe Analysis, (1) | 147 |
| Metallurgical Constr., (1) | 151 | Mineralogy, (3) | 145 |
| Crystallography, (2) | 144 | Metallurgical Constr., (2) | 151 |
| English, (2) | 60, 63 | Drawing, (1) | 150 |
| Public Speaking, (1) | 73 | English, (2) | 61, 63 |

SUMMER TERM.

Mechanical Technology, 118.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Strength of Materials, (4) | 96 | Metallurgy, (5) | 153 |
| Boilers, (1) | 115 | Steam Engine, (3) | 117 |
| Chemical Philosophy, (3) | 234 | Quantitative Analysis, (4) | 238 |
| Quantitative Analysis, (3) | 236 | Alternating Currents, (2) | 209 |
| Blowpipe Analysis, (1) | 148 | Electrical Eng., (2) | 210 |
| Elec. and Magnetism, (2) | 198 | Electrical Laboratory, (1) | 200 |
| Electrical Laboratory, (1) | 199 | | |
| Dynamos and Motors, (2) | 207 | | |
| English, (1) | 65 | | |

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 155 | Metallurgical Design, (2) | 152 |
| Quantitative Analysis, (3) | 247 | Ore Dressing, (3) | 186 |
| Blowpipe Analysis, (1) | 149 | Engineering Lab., (1) | 123A |
| Engineer'g Laboratory, (1) | 121 | Electric Power, (2) | 221 |
| Electric Lighting, (2) | 215 | Dynamo Laboratory, (2) | 223 |
| Dynamo Laboratory, (2) | 218 | Electrometallurgy, (1) | 158 |
| Theory of Electrolysis, (1) | 157 | Metallurgical Lab., (1) | 156 |
| Electrical Laboratory, (1) | 226 | Economics, (1) | 7 |
| Electromet. Lab., (1) | 159 | Philosophy of Religion, (1) | 5 |
| Economics, (1) | 6 | Thesis, (3) | 161 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN MINING ENGINEERING.

In developing this course, the following objects have been kept in view, in order that the graduate may be enabled—

1. To make surface or underground surveys, and to map the physiography and geology of a region.

2. To recognize readily by inspection the mineral bodies encountered in a survey; to value outcrops and properties; and to analyze given substances by wet, dry, or blowpipe methods, rather from the economic standpoint of the engineer than from the analytical one of a metallurgical chemist.

3. To make mining or metallurgical designs and constructions to meet the requirements of given cases.

After laying a thorough foundation in mathematics, physics, English, and modern languages, the ability to execute the first of the preceding objects is secured by courses in land, topographical, mine, geodetic, and geological surveying, including field work in the same; the second, by laboratory work in crystallography, mineralogy, microscopic petrography, chemical analysis, assaying and blowpiping, and by a course in economic geology, prospecting and the valuation of properties; the third, by extensive courses in strength of materials, graphical statics of trusses and mechanisms, hydraulics, steam engine, dynamos and motors, measurement of power, mining engineering and mining, ore-dressing, metallurgy, electrometallurgy, and electrical engineering, supplemented by visits to mining and metallurgical plants, which may furnish data for problems to be solved by courses in design based upon extensive practice in drawing, construction and graphical analysis. The school conducted during the summer of the Junior year in the coal regions enables the student to acquire practice in mine surveying and field geology and also to make sketches and details of parts of mining plant, which are subsequently utilized in the mining design of the year following.

The natural sciences of the course are taught in an eminently practical manner. The theory is first developed and then fully illustrated in such a manner that the student is carried forward, noting, identifying, and comparing as he proceeds. In Crystallography he handles accurately made models, applies the goniometer, and constructs the zone equation. From the necessary data he draws the crystal according to the best methods. In

Mineralogy he handles carefully selected specimens and, after learning the methods of identification by physical peculiarities, is taught to check these by blowpipe tests. In Petrology he masters the methods by the microscope; carries the mineral analysis one step further and applies these methods to determining the species of rocks which are of common and also of infrequent occurrences. In Geology these methods of discrimination and powers of classifying are directed to the study of the causes which have deformed or degraded the terranes which are brought to his notice, or to type fossils by which they are identified. After mastering these principles the student applies them in the field so that after graduation he should readily determine any rock, and approximately place any fossiliferous outcrop. These powers, combined with the knowledge of Economic Geology, will be directly valuable in a prospect or a geological survey.

The facilities for the study of economic geology and mining are almost unequalled, as within easy reach are mines of zinc ore, paint ore, brown hematite, magnetite, block and fossil hematites, and the great anthracite coal fields of the State; while quarries of limestone, sand, slate, and cement lie immediately in the vicinity of the University. The mechanical and metallurgical facilities are almost equally good, as in the same borough are the great armor, gun, and machine works of the Bethlehem Steel Co., and the spelter and oxide works of the New Jersey Zinc Co.

Graduates in this course receive the degree of Mining Engineer (E.M.).

## THE COURSE IN MINING ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Qualitative Analysis, (3) | 232 |
| Freehand Drawing, (2) | 84 | Stoichiometry, (2) | 233 |
| Mechanical Drawing, (3) | 188 | Land Surveying, (1) | 87 |
| Hygiene, (2) | 182 | German, (3) *or* French, (3) | 48 / 38 |
| English, (3) | 57, 58, 62 | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

SUMMER TERM.

Land Surveying, 88.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Crystallography, (2) | 144 | Mineralogy, (3) | 145 |
| Quantitative Analysis, (3) | 236 | Blowpipe Analysis, (1) | 147 |
| Chemical Philosophy, (3) | 234 | Quantitative Analysis, (3) | 245 |
| English, (2) | 60, 63 | Petrology, (2) | 163 |
| Public Speaking, (1) | 73 | English, (2) | 61, 63 |

SUMMER TERM.

Topographic Surveying, 89.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgical Constr., (3) | 151 | Mining Engineering, (3) | 183 |
| Geology, (2) | 167 | Mining, (2) | 184 |
| Assaying, (3) | 252 | Metallurgy, (5) | 153 |
| Boilers, (1) | 115 | Geology, (2) | 168 |
| Strength of Materials, (4) | 96 | Steam Engine, (4) | 116 |
| Petrology, (2) | 164 | Hydraulics, (3) | 108 |
| Blowpipe Analysis, (1) | 148 | | |
| OPTIONS. | | | |
| Biology, (3) *or* | 178 | | |
| Desc. Astronomy, (3) | 82 | | |

SUMMER TERM.

Mine Surveying, 187.

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mining Engineering, (3) | 185 | Mining Engineering, (3) | 186 |
| Metallurgy, (4) | 155 | Mining Design, (2) | 189 |
| Mech. of Machinery, (2) | 119 | Metallurgical Design, (2) | 152 |
| Electrotechnology, (2) | 224 | Electrometallurgy, (1) | 158 |
| Graphic Statics, (2) | 98 | Electrotechnology, (2) | 225 |
| Engineer'g Laboratory, (1) | 121 | Electrical Lab., (1) | 227 |
| Economics, (1) | 6 | Geological Surveying, (2) | 174 |
| OPTIONS. | | Engineering Lab., (1) | 123A |
| Geodetic Surveying, (3) *or* | 91 | Philosophy of Religion, (1) | 5 |
| Economic Geology, (3) | 170 | Economics, (1) | 7 |
| | | Thesis, (3) | 190 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is to give to the student a broad technical education with special reference to the requirements of Electrical Engineering. The course includes those general culture studies and those mathematical and scientific studies which constitute the basis of a sound technical education, and it affords special training in the various branches of electrotechnology and in closely allied branches of Mechanical and Civil Engineering.

Electives are offered during the Junior and Senior years, which enable the student to give to his course a trend towards Mechanical or Metallurgical Engineering, as he may desire. The student is required to indicate to the head of the Electrical Engineering department his choice of these electives, series (*a*) or series (*b*), on or before the 15th of December during the first term of his Junior year. The reading of French and German is included in the class work of the Senior year in Electrotechnical subjects.

The Electrical Engineering department library and reading room, located on the main floor of the department building, is provided with the leading electrical periodicals, with files of trade catalogues and circulars, and with standard reference books.

After consultation with the head of the Electrical Engineering department a part, not exceeding one-fourth, of the special work in electrotechnology may be replaced by an equivalent amount of work in Mechanical Engineering.

Opportunities for graduate study are offered by the Department of Physics and Electrical Engineering in the following subjects: Advanced Theory of Alternating Currents, Experimental Researches in Electrical Engineering, Theoretical Physics, and Physical Research.

Graduates in this course receive the degree of Electrical Engineer (E.E.).

## THE COURSE IN ELECTRICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Draw'g and Mach. Des., (3) | 112 |
| Freehand Drawing, (2) | 84 | German, (3) *or* French, (3) | 48 / 38 |
| Hygiene, (2) | 182 | English, (2) | 59, 62 |
| English, (3) | 57, 58, 62 | Public Speaking, (1) | 72 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 113, 206.

SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Machine Design, (3) | 114 | Steam Engine, (4) | 116 |
| Boilers, (1) | 115 | German, (2) *or* | 50 |
| German, (2) *or* | 49 | French, (2) | 40 |
| French, (2) | 39 | English, (2) | 61, 63 |
| English, (2) | 60, 63 | | |
| Public Speaking, (1) | 73 | | |

SUMMER TERM.

Mechanical Technology, 118.

JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 81 | Electrical Eng., (2) | 210 |
| Elec. and Magnetism, (2) | 198 | Alternating Currents, (2) | 209 |
| Dynamos and Motors, (2) | 207 | Electrical Laboratory, (1) | 200 |
| Electrical Laboratory, (1) | 199 | Hydraulics, (3) | 108 |
| Strength of Materials, (4) | 96 | Construction. (2) | 93 |
| Mech. of Machinery, (2) | 119 | Economics, (1) | 7 |
| Construction, (2) | 92 | OPTIONS. | |
| Economics, (1) | 6 | Mech. of Machinery, (3) | 124 |
| English, (1) | 65 | Graphic Dynamics, (3) | 122 |
| | | *or* | |
| | | Metallurgy, (3) | 154 |
| | | Stoichiometry, (2) | 233 |
| | | Qualitative Anal., | 232 |

SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Theory of Alt. Cur., (2) | 212 | Theory of Alt. Cur., (2) | 219 |
| Dynamo Elec. Mach'y, (3) | 213 | Electrical Design, (2) | 220 |
| Electrical Design, (2) | 214 | Electric Power, (2) | 221 |
| Electric Lighting, (2) | 215 | Dynamo Laboratory, (2) | 223 |
| Teleg's and Telephones, (2) | 217 | Engineering Lab., (1) | 123A |
| Dynamo Laboratory, (2) | 218 | Electrical Seminary, (1) | 222 |
| Electrical Seminary, (1) | 216 | Electrometallurgy, (1) | 158 |
| Engineer'g Laboratory, (1) | 121 | Philosophy of Religion, (1) | 5 |
| OPTIONS. | | Thesis, (3) | 228 |
| Machine Design, (2) | 130 | OPTIONS. | |
| *or* | | Machine Design, (2) *or* | 137 |
| Theory of Electrol., (1) | 157 | Metallurgical Design, (2) | 152 |
| Electrical Lab., (1) | 226 | | |

A special option in Mechanical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine.

Instruction in Theoretical Chemistry is begun in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry, with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Theoretical Chemistry. In the first term of the Junior year there is a course of lectures and recitations on theoretical organic chemistry.

Qualitative Analysis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the Assay of gold and silver bullion are taught in the first term of the Senior year by lectures and laboratory work. The analysis of various commercial products is taken up in the second term of the Senior year, also the subjects of Sanitary and Agricultural Chemistry and Toxicology. Instruction is also given in Manufacturing Chemistry, Dyeing, Calico Printing, and Bleaching. Blowpipe analysis also is included in the course.

The practical work in Organic Chemistry is performed in the second term of the Junior year, with laboratory work and conference. There are also courses of practical Microscopy and Electrochemistry, and Toxicology. Physical Chemistry is taught by text-book and laboratory work. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated, and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hempel's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas's, and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City. A well equipped photographic laboratory and dark rooms are provided, in which the students of the Chemical course receive practical instruction. There is also a course in Microscopy.

Graduates in this course receive the degree of Analytical Chemist (A.C.).

## THE COURSE IN CHEMISTRY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Qualitative Analysis, (6) | 231 |
| Chemistry, (2) | 229 | Stoichiometry, (2) | 233 |
| Chemical Laboratory, (2) | 230 | Physics, (2) | 191 |
| German, (3) *or* | 47 | Physical Laboratory, (1) | 192 |
| French, (3) | 37 | German, (3) *or* | 48 |
| Freehand Drawing, (2) | 84 | French, (3) | 38 |
| Hygiene, (2) | 182 | English, (2) | 59, 62 |
| English, (3) | 57, 58, 62 | Public Speaking, (1) | 72 |

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Chemical Philosophy, (3) | 234 | Physics, (3) | 196 |
| Quantitative Analysis, (6) | 235 | Physical Laboratory, (1) | 197 |
| Quant. Anal. Conf., (1) | 237 | Quantitative Analysis, (6) | 239 |
| Physics, (3) | 193 | Quant. Anal. Conf., (1) | 241 |
| Physical Laboratory, (1) | 195 | Theoretical Chemistry, (3) | 242 |
| English, (2) | 60, 63 | English, (2) | 61, 63 |
| Public Speaking, (1) | 73 | | |

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Toxicology, (2) | 243 | Organic Chem. Lab., (6) | 249 |
| Quantitative Analysis, (6) | 244 | Org. Chem. Conf., (1) | 250 |
| Quant. Anal. Conf., (1) | 246 | Metallurgy, (5) | 153 |
| Organic Chemistry, (5) | 248 | Mineralogy, (3) | 145 |
| Crystallography, (2) | 144 | Blowpipe Analysis, (1) | 147 |
| Economics, (1) | 6 | Economics, (1) | 7 |
| English, (1) | 65 | Technical German, (1) | 263 |

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 155 | Industrial Chemistry, (3) | 254 |
| Assaying, (3) | 252 | Industrial Analysis, (3) | 255 |
| Industrial Chem. Lab., (3) | 251 | Ind. Anal. Conf., (1) | 256 |
| Lithology, (2) | 162 | Agricult'l Chem. Lab., (1) | 257 |
| Microscopy, (2) | 253 | Sanitary Chem. Lab., (1) | 258 |
| Blowpipe Analysis, (1) | 148 | Geology, (4) | 166 |
| Physical Chemistry, (1) | 259 | Electrochemistry, (1) | 261 |
| Phys. Chem. Lab., (1) | 260 | Electrochem. Lab., (1) | 262 |
| | | Electrometallurgy, (1) | 158 |
| | | Electromet. Lab., (1) | 159 |
| | | Philosophy of Religion, (1) | 5 |
| | | Thesis, (3) | 264 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN CHEMICAL ENGINEERING.

This course of study is designed to prepare students for the profession of the chemical engineer, engaged in the construction and management of manufacturing establishments involving chemical principles, such as sugar refineries, gas works, superphosphate works, bleacheries, dye works, oil refineries, fertilizer works, soap works, sulphuric acid plants, soda works, etc.

In addition to many of the subjects in the Course in Chemistry, it includes the subjects of elementary mechanics, boilers, steam engine, drawing and machine design, constructive elements of machinery, measurement of power, mechanics of machinery, mechanical technology, and work in the engineering laboratory. It also includes electricity and magnetism, dynamos and motors, and work in the electrical and dynamo laboratories.

In this course the training is essentially chemical and the graduates are primarily chemists with a good knowledge of mechanical engineering.

This equipment is considered more valuable for the chemical engineer than a fundamental training in engineering and a somewhat limited knowledge of chemistry, since the problems of the manufacturing chemist are not essentially mechanical ones. Although six years' work covering most of the studies of both the chemical and mechanical courses would be found advantageous for the chemical engineer, this shorter course, of four years, will be found to meet most of his requirements.

Graduates of this course receive the degree of Chemical Engineer (Ch.E.).

## THE COURSE IN CHEMICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* | 47 | Qualitative Analysis, (3) | 232 |
| French, (3) | 37 | Stoichiometry, (2) | 233 |
| Freehand Drawing, (2) | 84 | German, (3) *or* | 48 |
| Hygiene, (2) | 182 | French, (3) | 38 |
| English, (3) | 57, 58, 62 | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 113, 206.

## SOPHOMORE YEAR.

FIRST TERM.

| | |
|---|---|
| Chemical Philosophy, (3) | 234 |
| Quantitative Analysis, (6) | 235 |
| Quant. Anal. Conf., (1) | 237 |
| Boilers, (1) | 115 |
| Physics, (3) | 193 |
| Physical Laboratory, (1) | 195 |
| English, (2) | 60, 63 |
| Public Speaking, (1) | 73 |

SECOND TERM.

| | |
|---|---|
| Theoretical Chemistry, (3) | 242 |
| Quantitative Analysis, (2) | 240 |
| Steam Engine, (4) | 116 |
| Draw'g and Mach. Des., (3) | 112 |
| Physics, (3) | 196 |
| Physical Laboratory, (1) | 197 |
| English, (2) | 61, 63 |

SUMMER TERM.

Mechanical Technology, 118.

## JUNIOR YEAR.

FIRST TERM.

| | |
|---|---|
| Quantitative Analysis, (2) | 247 |
| Organic Chemistry, (5) | 248 |
| Engineer'g Laboratory, (2) | 120 |
| Elec. and Magnetism, (2) | 198 |
| Electrical Laboratory, (1) | 199 |
| Dynamos and Motors, (2) | 208 |
| Machine Design, (3) | 114 |
| English, (1) | 65 |

SECOND TERM.

| | |
|---|---|
| Organic Chem. Lab., (6) | 249 |
| Org. Chem. Conf., (1) | 250 |
| Metallurgy, (5) | 153 |
| Engineer'g Laboratory, (1) | 123 |
| Electrical Eng., (2) | 211 |
| Electrical Laboratory, (1) | 200 |
| Technical German, (1) | 263 |

SUMMER TERM.

Engineering Laboratory, 125.

## SENIOR YEAR.

FIRST TERM.

| | |
|---|---|
| Industrial Chem. Lab., (3) | 251 |
| Assaying, (3) | 252 |
| Metallurgy, (4) | 155 |
| Microscopy, (2) | 253 |
| Engineer'g Laboratory, (1) | 131 |
| Mech. of Machinery, (2) | 119 |
| Physical Chemistry, (1) | 259 |
| Phys. Chem. Lab., (1) | 260 |
| Economics, (1) | 6 |

SECOND TERM.

| | |
|---|---|
| Industrial Chemistry, (3) | 254 |
| Industrial Analysis, (3) | 255 |
| Ind. Anal. Conf., (1) | 256 |
| Agricult'l Chem. Lab., (1) | 257 |
| Sanitary Chem. Lab., (1) | 258 |
| Electrochemistry, (1) | 261 |
| Electrochem. Lab., (1) | 262 |
| Electrometallurgy, (1) | 158 |
| Electromet. Lab., (1) | 159 |
| Economics, (1) | 7 |
| Philosophy of Religion, (1) | 5 |
| Thesis, (3) | 264 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN GEOLOGY.

The course in Geology is the same as that in Mining Engineering up to the end of the Sophomore year and differs in only a few respects from it up to the end of the first term Junior year. It is designed for those who wish the thorough grounding of the engineering courses, but whose tastes lead them into the natural sciences rather than into technical lines. The studies for the first two years are equally necessary for the thoroughly educated man in either, and by this arrangement the student is not required to decide which course he will follow until he has had an opportunity to test his own tastes and abilities.

After completing the course in Geology one year of graduate work will enable the student to secure the degree of Engineer of Mines and the graduate from the Mining Engineering course in the same way, by taking a year's work in the geological specialties as a major subject with the addition of a minor subject from another department, can complete the course in Geology and receive the degree of Master of Science.

The course meets the requirements of the teacher of the natural sciences, the field geologist, or the prospecting and exploring engineer, and furnishes especially a broad, thorough basis for the subsequent prosecution of original research. Throughout the entire four years the work gives a first-hand knowledge of the subjects taught and cultivates self-reliance and the powers of perception and exact reasoning. For those who may wish ultimately to become specialists in some one of the different branches of Geology this course is recommended with a year of graduate work at one of the larger Universities.

It includes the Mathematics and Physics taught in the technical courses, thus ensuring an ability to grasp and solve the problems of geological dynamics. A year's knowledge of French or German is necessary for entrance and this is continued by a year and a half of work in the same language. Two years' work in the other language is required during the Junior and Senior years, so that by the end of the course the student feels at home with foreign periodical literature in both French and German. Spanish also is taught during the Senior year.

A thorough knowledge of Surveying is considered at the present time indispensable to the field geologist, and the courses, being the same as those for the mining engineer, not only offer a ready means of livelihood for young men just graduated, but

afford practice in accurate mapping and give the proper basis for the interpretation of topography. The course in geodesy gives the methods of triangulation and the adjustment by least squares.

The preliminary courses in Crystallography, Mineralogy, Petrology, and Geology are the same as those given to the mining engineers and will permit the student with slight effort not only to recognize any of the constituents of the earth's crust, but to value the portion surveyed from an economic standpoint as it is adapted or not for mining operations. In addition to these are the more purely scientific courses. Throughout the Junior year three periods a week are set aside for field Geology to accompany the first year's work. The Petrology is continued through the second term Junior year; the student, having passed briefly over the general subject of Petrology, spends this time in studying some particular phases and becoming familiar with detailed methods which cannot be given in the briefer course. A course in advanced Geology devoted chiefly to Paleontology runs through the Senior year, a text-book being used and the student handling and identifying numerous invertebrate fossils. It is not designed to make a paleontologist, but to give that amount of systematic knowledge and ability to identify fossils which should be possessed by the stratigraphical geologist or to give a basis for one who wishes to pursue the subject further.

The several branches of Geology are so widely separated and require such different kinds of ability that in the second term Senior year an opportunity is given for the student to specialize. In the studies in Pennsylvania Geology he takes up some branch of the subject, reads the literature that bears upon it, and makes field studies over regions within reasonable distances. Original research is more properly left for graduate work, but this course is preparatory to it by showing the student the extent to which he must go before hoping to turn out new material. Some phases of the subject, however, embracing his own observations and deductions may properly be handed in for a thesis.

The ordinary courses in Geology are extended by excursions into the foundations of Botany, Zoölogy, and Biology, and supplemented by work in the field in the courses in Surveying and Physiography. The ability readily to determine the character and value of the ores and minerals met with is guaranteed by extended courses in Crystallography, Mineralogy, Megascopic and Microscopic Rock Analysis, Economic Geology, and both Chemical and Blowpipe Analysis. The course in Chemistry includes

assaying, quantitative wet analysis and the discussion of chemical problems, so that mineralogical formulæ can be calculated from the results of analyses. The blowpipe courses cover qualitative and quantitative work. Economic Geology is taught in a thorough manner and applied by courses in refractory materials and general metallurgy which contain problems depending upon the composition and impurities of ores and gangues; and by a course in prospecting which treats of the presentation of ores and gangues at the surface and the rules for their discovery.

The courses in general Metallurgy and Hydraulics are of indirect scientific value to the geologist, since the first renders him familiar with the composition, behavior, and fluidity of slags, as well as with blast furnace reactions, and the course in hydraulics develops the principles of moving fluids with their practical applications and serves as an introduction to the subject of geologic dynamics.

Beginning in the first term Junior year the student is given the choice of making the course a purely scientific one, or one embracing a little more technical work, assaying and mining engineering being made an alternative option with field work in geology.

Graduates in this course receive the degree of Bachelor of Science (in Geology).

## THE COURSE IN GEOLOGY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* | 47 | Land Surveying, (1) | 87 |
| French, (3) | 37 | German, (3) *or* | 48 |
| Freehand Drawing, (2) | 84 | French, (3) | 38 |
| Mechanical Drawing, (3) | 188 | Qualitative Analysis, (3) | 232 |
| Hygiene, (2) | 182 | Stoichiometry, (2) | 233 |
| English, (3) | 57, 58, 62 | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

SUMMER TERM.

Land Surveying, 88.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Crystallography, (2) | 144 | Mineralogy, (3) | 145 |
| Chemical Philosophy, (3) | 234 | Blowpipe Analysis, (1) | 147 |
| German, (2) *or* | 49 | Petrology, (2) | 163 |
| French, (2) | 39 | English, (2) | 61, 63 |
| English, (2) | 60, 63 | | |
| Public Speaking, (1) | 73 | | |

SUMMER TERM.

Topographic Surveying, 89.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Geology, (2) | 167 | Geology, (2) | 168 |
| Biology, (3) | 178 | Petrology, (2) | 165 |
| Petrology, (2) | 164 | Quantitative Analysis, (3) | 245 |
| Blowpipe Analysis, (1) | 148 | Metallurgy, (3) | 154 |
| Quantitative Analysis, (3) | 236 | Economics, (1) | 7 |
| Economics, (1) | 6 | French, (2) *or* | 36 |
| French, (2) *or* | 35 | German, (2) | 46 |
| German, (2) | 45 | Botany, (2) | 176 |
| English, (1) | 65 | OPTIONS. | |
| OPTIONS. | | Field Geology, (3) *or* | 173 |
| Field Geology, (3) *or* | 172 | Mining Engin'g, (3) | 183 |
| Assaying, (3) | 252 | | |

SUMMER TERM.

Mine Surveying, 187.

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Geology, (4) | 169 | Physiography, (3) | 171 |
| Economic Geology, (3) | 170 | Hydraulics, (3) | 108 |
| Descriptive Astronomy, (3) | 82 | French, (3) *or* | 38 |
| French, (3) *or* | 37 | German, (3) | 48 |
| German, (3) | 47 | Spanish, (2) | 56 |
| Spanish, (2) | 55 | Philosophy of Religion, (1) | 5 |
| Geodetic Surveying, (3) | 91 | Thesis, (3) | 181 |
| | | OPTIONS. | |
| | | Pennsylvania Geology, (5) | 175 |
| | | *or* | |
| | | Geological Surveying, (2) | 174 |
| | | Pennsylvania Geology, (3) | 175 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN PHYSICS.

This course is designed to meet the requirements of the student who wishes to prepare for the teaching of Physics, or who wishes to pursue a graduate course of study in this science. The requirements for entrance to this course are the same as the requirements for entrance to the School of Technology.

As far as possible the same electives are offered during the Junior and Senior years. The available electives of the second term depend, however, upon the work which has been done during the first term. Thus, second term American History is open only to those who have taken first term American History; second term Politics is open only to those who have taken first term Politics; second term Psychology is open only to those who have taken first term Psychology; Mineralogy is open only to those who have taken Crystallography; and Practical Astronomy is open only to those who have taken Descriptive Astronomy. The character and scope of these elective studies and of the various required studies in the course, are described in the List of Studies on pages 36 to 69.

The seminary work of the Senior year consists of the participation in the work of the Physical Seminary which meets on alternate Tuesday evenings for the discussion of current literature in Physics. The membership of this seminary is made up of the corps of instructors of the department of Physics and Electrical Engineering together with graduate students and senior students taking the course in Physics.

Graduates in this course receive the degree of Bachelor of Science (in Physics).

## THE COURSE IN PHYSICS.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Algebra and Trig., (4) | 74, 75 | Elementary Mechanics, (5) | 78 |
| Chemistry, (2) | 229 | Physics, (2) | 191 |
| Chemical Laboratory, (2) | 230 | Physical Laboratory, (1) | 192 |
| German, (3) *or* French, (3) | 47 / 37 | Qualitative Analysis, (2) | 233 |
| Freehand Drawing, (2) | 84 | Stoichiometry, (2) | 233 |
| Hygiene, (2) | 182 | German, (3) *or* French, (3) | 48 / 38 |
| English, (3) | 57, 58, 62 | English, (2) | 59, 62 |
| | | Public Speaking, (1) | 72 |

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 79 | Calculus, (5) | 80 |
| Physics, (3) | 193 | Physics, (3) | 196 |
| Physical Laboratory, (1) | 195 | Physical Laboratory, (1) | 197 |
| Chemical Philosophy, (3) | 234 | Projection Drawing, (3) | 85 |
| French, (2) *or* | 35 | Land Surveying, (1) | 87 |
| German, (2) | 45 | French, (2) *or* | 36 |
| English, (2) | 60, 63 | German, (2) | 46 |
| Public Speaking, (1) | 73 | English, (2) | 61, 63 |

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 81 | Alternating Currents, (2) | 209 |
| Elec. and Magnetism, (2) | 198 | Electrical Laboratory, (1) | 200 |
| Dynamos and Motors, (2) | 208 | French, (3) *or* | 38 |
| Electrical Lab., (2) | 199, 200 | German, (3) | 48 |
| French, (3) *or* | 37 | Economics, (1) | 7 |
| German, (3) | 47 | (*Elective, ten hours*) | |
| Economics, (1) | 6 | History, (2) | 13 |
| English, (1) | 65 | European History, (1) | 12 |
| (*Elective, four to six hours*) | | Economics, (2) | 9 |
| European History, (1) | 12 | Politics, (2) | 11 |
| Economics, (2) | 8 | Psychology, (2) | 2 |
| Psychology, (2) | 1 | Hydraulics, (3) | 108 |
| Politics, (2) | 10 | Mineralogy, (3) | 145 |
| Crystallography, (2) | 144 | Metallurgy, (3) | 154 |
| Organic Chemistry, (5) | 248 | Practical Astronomy, (2) | 83 |
| Strength of Materials, (4) | 96 | | |
| Descriptive Astronomy, (3) | 82 | | |
| Perspective, (2) | 103 | | |

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| European History, (1) | 12 | Theory of Heat, (4) | 202 |
| Theory of Light, (5) | 201 | Physical Seminary, (2) | 204 |
| Physical Laboratory, (2) | 203 | Philosophy of Religion, (1) | 5 |
| Physical Seminary, (2) | 204 | Thesis, (3) | 205 |
| (*Elective, eight hours*) | | (*Elective, eight hours*) | |
| European History, (1) | 12 | History, (2) | 15 |
| History, (2) | 14 | European History, (1) | 12 |
| Economics, (2) | 8 | Economics, (2) | 9 |
| Psychology, (2) | 1 | Politics, (2) | 11 |
| Politics, (2) | 10 | Psychology, (2) | 2 |
| Crystallography, (2) | 144 | Hydraulics, (3) | 108 |
| Organic Chemistry, (5) | 248 | Mineralogy, (3) | 145 |
| Strength of Materials, (4) | 96 | Geology, (4) | 166 |
| Descriptive Astronomy, (3) | 82 | Metallurgy, (3) | 154 |
| Lithology, (2) | 162 | Practical Astronomy, (2) | 83 |
| Perspective, (2) | 103 | | |

**The figures in parentheses indicate the number of exercises per week.**

## GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

## DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

## THE UNIVERSITY MUSEUMS.

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet has over ten thousand specimens and includes the Paleontological, Mineralogical, Petrographic, and Economic collections. The first contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Roepper collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petrographic division numbers several thousand specimens and, in addition to numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and given by Dr. James P. Kimball, ex-Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

## UNIVERSITY LECTURES.

From time to time during the University year, distinguished members of the various professions are invited to lecture before the student-body upon those special subjects to which they have given particular attention and upon which they are authorities.

The following lectures were given in this course during the year 1901-1902:

Mr. James B. Reynolds, "The Recent Municipal Campaign in New York."

Dr. Edward T. Devine, "The Housing of the Poor."

Mr. Frank Moss, "Morality and Politics."

Mr. H. T. Newcomb, "Recent Railway Combinations."

Mr. Samuel Gompers, "Labor's Struggles and Aspirations."

Hon. Edward M. Shepard, "The Use of Political Parties in Municipal Elections."

Mr. James B. Dill, "The Pros and Cons of the Trust Problem."

Rev. Charles C. Pierce, "The Situation in the Philippines."

Prof. Leo S. Rowe, "The Problem of Civil Government in Porto Rico."

Mr. Alfred Walter, "Technical Training as an Aid to Administrative Methods."

## THE CHEMICAL AND NATURAL HISTORY SOCIETY OF LEHIGH UNIVERSITY.

This Society was organized in the fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

## THE ENGINEERING SOCIETIES.

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the

Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

Recently the Civil Engineering and Mechanical Engineering sections have formed independent societies, with monthly meetings for the reading and discussion of papers relating to engineering subjects of their particular departments.

## THE ELECTRICAL ENGINEERING SOCIETY.

This Society was organized in 1887. Its object is to supplement the regular work in Electrical Engineering by the discussion of current topics in electricity and by lectures given under the auspices of the Society by engineers and by members of the corps of instructors in the department of Electrical Engineering.

## THE FORUM.

The Forum, a literary and debating society which meets semi-monthly, was organized in 1897. This Society has proved of great advantage to its members in the development of concise and logical thinking, in the promotion of ease before an audience, and in the acquirement of experience in parliamentary methods. Through this Society the University is represented in the Pennsylvania Intercollegiate Oratorical Union. An annual contest in debate is held with representatives of the literary societies of several other colleges. The Forum has justified its existence by the great increase in the amount of attention given, not only to training in oratory and debate, but also to those subjects of the day which are constantly discussed at its meetings.

## THE MATHEMATICAL CLUB.

This Club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University. It holds frequent meetings, at which papers are read and discussed by its members.

## THE ECONOMIC SOCIETY.

This Society meets on the second and fourth Tuesday of each month of the college year. Under the direction of the Professor

of Economics the Society serves as a training place for the students of the upper classes for the discussion and application of economic principles to current questions.

## THE Y. M. C. A. OF THE UNIVERSITY.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, a college graduate, being chosen from the student-body.

## FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 9, 1902, the twenty-third Founder's Day was celebrated. An address was delivered by the Hon. James M. Beck, Assistant Attorney General of the United States. His subject was "Commercialism."

## UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day. The Rev. William S. Rainsford, D.D., Rector of St. George's Church, New York, N. Y., was the preacher on Sunday, June 15, 1902, in the Packer Memorial Church.

## THESES.

Theses on the following subjects were prepared by candidates for degrees in 1902:

### FOR THE DEGREE OF MASTER OF SCIENCE.

ALBERT GEORGE RAU, B.S., Bethlehem.
Some Notes on the Condition of Society in Gaul during the Fourth, Fifth, and Sixth Centuries.

ERNESTO FRANCO, C.E., Quito, Ecuador.
Detail Plans and Estimates for the Sewerage Plant to be Constructed in 1902 and 1903 in South Bethlehem, Pa.

### FOR THE DEGREE OF BACHELOR OF ARTS.

MYRON JACOB LUCH, Santee.
The Prologue of Piers the Plowman.

FOR THE DEGREE OF BACHELOR OF SCIENCE.

WILLIAM BERGER GEISER, Wyncote.
The Utilization of Slate Waste in Making Cement.

FOR THE DEGREE OF CIVIL ENGINEER.

WILLIAM TAGGART CARPENTER, Pittston.
The Discharge of the Lehigh River at Bethlehem, Pa., from November, 1901, to June, 1902.

EDWARD RANDOLPH EICHNER, Hoboken, N. J.
Investigation of the Freight and Passenger Elevator up the Palisades near Hoboken, N. J.

HENRY LEROY FRYER, Chester.
Comparative Tests of Several Kinds of Paving Brick.

CASTULO GALLARDO, Guadalajara, Mexico.
The Discharge of the Lehigh Canal and the Manocacy Creek at Bethlehem, Pa.

JOHN THOMAS GAVAN, Scranton.
The Railroad Grade Crossings in South Bethlehem, Pa., and the Methods of Protection against Accidents.

FELIX GOLIAN, Phoenixville.
Design for a Bridge over the Lehigh River between Bethlehem and South Bethlehem, Pa.

WILLIAM RANKIN HALL, Middletown, Del.
Inspection and Discussion of the Sewage Disposal Plant at Reading, Pa.

WALTER SCOTT HANNA, Lykens.
Design of a Sewerage System for Lykens, Pa.

ALBERT CASS HUTCHINSON, Mishawaka, Ind.
Design for a Viaduct Approach to the Proposed Bridge over the Lehigh River at South Bethlehem, Pa.

WALTER SCOTT JOHNS, JR., Martindale.
Tests to Determine the Coefficient of Elasticity of Timber in Tension and in Shear.

WILLIAM LLOYD MORGAN, Harwood Mines.
Tests on the Influence of Mine Water upon the Strength of Cement and Concrete.

CHARLES EDWIN PUGH MURRAY, Columbia.
Design of a Two-Million Gallon Filter Bed for Columbia, Pa.

WILLIAM PENN SLIFER, Bingen.
Discussion of the Different Floor Systems used for Railroad Bridges.

EDMUND SEWELL STEVENS, Bristol.
Design for an Economical Bridge over the Manocacy Creek on Main Street, Bethlehem, Pa.

ROBERT WILLIAM THOROUGHGOOD, Georgetown, Del.
The Causes which Produce and Affect the Ton-Mile Freight Rate.

FOR THE DEGREE OF MECHANICAL ENGINEER.

ROBERT MONTGOMERY BIRD, South Bethlehem.
The Steam Engine Compared with Electric and Internal Combustion Motors, as Applied to the Automobile.

PETER WILLIAM GLEASON, South Bethlehem.
Design of a Four-Cycle Gas Engine.

JOHN S. HEGEMAN, Bethlehem.
The Machinery Market Needed by Civil Engineers in the Construction of Public Works.

WILLIAM HENRY JAXHEIMER, Bethlehem.
Design of a Twelve Inch Mortar Gun with an Expansion Breech Mechanism.

WILLIAM FRANK ROBERTS, Freeland.
A Comparison of Compressed Air and Electricity as Motive Powers for Mine Haulage.

DANIEL MARTIN SACHS, JR., Gowen.
Preliminary Design of a 550 H. P. High Pressure Pumping Engine.

FOR THE DEGREE OF METALLURGICAL ENGINEER.

ROBERT FRANKLIN GROSS, Bethlehem.
Investigation of the Working of Furnace No. 3 of the Thomas Iron Co., at Hokendauqua, Pa.

FOSTER HEWETT, Colorado Springs, Col.
Investigation of Cyanide Consumption in the Treatment of Gold Ores.

WALTER SAVAGE LANDIS, Pottstown.
A New Method of Quantitative Blowpipe Analysis for Some of the Bead-coloring Oxides.

FREDERICK FARRAR LINES, Bethlehem.
A Study of the Influence of Heat Treatment upon the Microstructure of 55 Carbon Steel.

FOR THE DEGREE OF MINING ENGINEER.

JAMES MITCHELL DANIEL, JR., Paris, Tex.
Silver Mining, District of Jalpa, Zacatecas, Mexico.

STUART RHETT ELLIOTT, B.S., Ishpeming, Mich.
Geology of the Ashland, Pa., Mine.

MAXIMILIAN SHOWZO HACHITA, Sanuki, Japan.
Determination of Minerals.

EDWIN HIGGINS, JR., Washington, D. C.
Phosphate Mining in the United States and Canada.

CHARLES EDGAR KENDIG, Baltimore, Md.
Mine Accidents.

FLOYD WILLIAM PARSONS, Grafton, W. Va.
Mine Ventilation.

WILLIAM ERNEST THOMAS, Philadelphia.
Influence of Dust in Mine Explosions.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

FREDERICK ARTHUR ARMSTRONG, (with R. F. TAYLOR), Brooklyn, N. Y.
An Experimental Study of Alternating Current Power Measurement.

JOHN ATKINSON CUNNINGHAM, (with J. A. SIMONS), Henderson, Ky.
An Experimental Study of an Induction Motor.

JAMES NETHERMARK DOWNEY, (with P. H. Smith), Lancaster.
An Experimental Study of the Regulation of Alternators.

ELMER MCCLELLAN MILHEIM, Bloomsburg.
Electric Power Equipment for Mills and Factories.

JOSEPH AIKEN SIMONS, (with J. A. CUNNINGHAM), Charleston, S. C.
An Experimental Study of an Induction Motor.

PAUL HELSEL SMITH, (with J. N. DOWNEY), Butler.
An Experimental Study of the Regulation of Alternators.

RICHARD FERRIER TAYLOR, (with F. A. ARMSTRONG), Bethlehem.
An Experimental Study of Alternating Current Power Measurement.

FOR THE DEGREE OF ANALYTICAL CHEMIST.

ARTHUR GARFIELD BACHMAN, Lancaster.
Arachis or Peanut Oil: its Manufacture, Detection, Adulteration, and Uses.

ALPHA ALBERT DIEFENDERFER, Allentown.
Underburnt and Overburnt Cement.

CHARLES ALBERT GRADWOHL, South Bethlehem.
Use and Detection of Formaldehyde in the Preservation of Food.

WILLIAM LOUIS HEIM, Kane.
Diacetin.

JOHNSON MCVEY, South Bethlehem.
The Determination of Chromium in Iron and Steel.

## UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1903 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

### EXERCISES ON JUNE 18, 1902.

MUSIC.

PRAYER.

MUSIC.

Salutatory Oration.—"Strikes in the Anthracite Coal Regions."
WILLIAM FRANK ROBERTS.

MUSIC.

Oration.—"Science and National Supremacy."
WALTER SAVAGE LANDIS.

Oration.—"Functions of a University."
MYRON JACOB LUCH.

Oration.—"Government Ownership of Railroads."
HENRY LEROY FRYER.

MUSIC.

Alumni Address.—"A Suggested Addition to the Curriculum."
A. PARKER SMITH, M.E., LL.B.,
Class of 1884.

MUSIC.

Valedictory Oration.—"Japan among Modern Nations."
MAXIMILIAN SHOWZO HACHITA.

MUSIC.

Address to the Graduating Class,
PROF. EDWARD H. WILLIAMS, JR., A.C., E.M., '75.

Award of the Wilbur Scholarship to
OLIVER JACOB HALLER, of Pittsburg.
First in rank in the Sophomore Class.

The Price Prize for English Composition, open to members of the Freshman Class, was awarded to
GEORGE HENRY SHENBERGER, of Manchester.

The Williams Prizes for Excellence in English Composition, open to members of the Sophomore Class, were awarded to
LESTER BERNSTEIN, of Philadelphia.
JACOB H. BRILLHART, of Loganville.
HOWARD M. PREVOST MURPHY, of Philadelphia.
RALPH LUCAS TALLEY, of Williamsport.
FRANK G. BURROWS, of Williamsport.
HENRY LANDON JACKSON, of Scranton.
HAROLD PATTERSON RENO, of Pittsburg.
ARTHUR JAMES WESTON, of Scranton.

The Wilbur Prizes, for excellence in the studies of Freshman year, were awarded as follows:

In Mathematics, to
FRANK HORACE BROWNING, of Washington, D. C., and
EARLEY MCILHENNY JOHNSON, of Steelton.

In German, to
JOHN ADLUM DENT, of Brookland.

In French, to
EARL VICTOR PHELPS, of Washington, D. C.

In English, to
RALPH G. KIRK, of Harrisburg.

In Freehand Drawing, to
WILLIAM HOMER HENDRICKS, of Hummelstown,
LOUIS FREDERICK BLUME, of Philadelphia, and
EDWIN LOUIS RICH, of Washington, D. C.

In General Chemistry, to
ARTHUR FREDERIC MURRAY, of Bethlehem.

Prizes for Excellence in Declamation, open to members of the Freshman Class, were awarded to
EDWIN HARDING CLARKE, of Baltimore, Md.
ALBERT WRIGHT ZAHNISER, of Mercer.
DEAN CORSA, of Washington, D. C.

## HONOR LIST, 1902.

### JUNIOR HONORS.

Classical Course. First: Arthur Simon Gilmore, of Williamsport. Second: Canby Guy Lord, of Williamsport.

Latin-Scientific Course. Bowdewine Bertrand Van Sickle, of Unionville, N. Y.

Civil Engineering Course. First: Norman Zabriskie Ball, of Whippany, N. J. Second: Walter David Gernet, of Nazareth.

Mechanical Engineering Course. First: William Henry Myers, of York. Second: Chauncy Shackford Curtis, of New Castle.

Electrical Engineering Course. First: John Joseph Cort, of Latrobe. Second: Raymond Hunt, of Stockton, N. J.

### SOPHOMORE HONORS.

In Mathematics. First: Oliver Jacob Haller, of Pittsburg. Second: Howard Mallet Prevost Murphy, of Philadelphia. Third: John Russell Coyle, of Easton.

In English. First: Frank G. Burrows, of Williamsport, Ralph Lucas Talley, of Williamsport. Second: Lester Bernstein, of Philadelphia.

In Physics. First: Oliver Jacob Haller, of Pittsburg. Second: William Henry Welker, of Red Hill. Third: Howard Mallet Prevost Murphy, of Philadelphia.

### FRESHMAN HONORS.

Same as Wilbur Prizes, above.

Degrees were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

## THE WILBUR SCHOLARSHIP.

This scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

## THE HARRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200, which is to be devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

## THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS.

Friends of the late Frederick Mercur, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, have contributed and placed in the hands of the Trustees a fund, to be called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of four scholarships for free tuition in the University.

## THE ECKLEY B. COXE MEMORIAL FUND.

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $28,000, the interest of which is to be used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

## THE FRANK WILLIAMS FUND.

Mr. Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate to found a Fund, the income of which is to be lent to deserving students. The bequest becomes available for this purpose in 1905.

## WILBUR PRIZES.

A fund has been established, yielding an annual income of $100, by E. P. Wilbur, Esq., for distribution in prizes as the Faculty shall determine.

## THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of ideas. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intention not later than the first of April.

The subject for the prize essay in June, 1903, will be: "Matthew Arnold's Prose and Poetry."

## ALUMNI PRIZES.

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, has with the consent of the contributors been diverted from this purpose and the income will in the future be used for prizes to members of the Junior Class. In June, 1903, two prizes of $25 each will be awarded to the first honor men of the courses in Civil and Mechanical Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

## ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of Lehigh University" established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following

### REGULATIONS.

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1902 with the following competitors:

Courtland F. Carrier, jr., of Elmira, N. Y.

Henry Antonio Firpo, of Paris, France.

George Kendrick Goodwin, of Philadelphia.

Chester B. Graham, of Washington, D. C.

George Rosebery Stull, of Ridley Park.

Whitmell P. Tunstall, of Washington, D. C.

The First Prize was awarded to H. A. Firpo; the Second to G. K. Goodwin, and the Third to G. R. Stull.

The judges were Mr. J. D. Hoffman, '83, of Bethlehem; Mr. H. A. Foering, '90, of Bethlehem; and the Rev. S. U. Mitman, of South Bethlehem.

## WILLIAMS PRIZES IN ENGLISH AND ORATORY.

Prof. Edward H. Williams, jr., established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize," of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amounts of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section where there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or their committee, shall meet on the above date and at subsequent adjourned meetings and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are

up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded; but the sum of one hundred and fifty dollars, which is in the hands of the President to pay for them, shall be used by him in such manner as he shall see fit to encourage public speaking in the University.

If one or more dissertations are admitted as aforesaid, the Faculty, or their committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or their committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

If fewer than six candidates shall present dissertations, or fewer than six dissertations shall be admitted to the contest, the whole, or such part of the sum of the above one hundred and fifty dollars as shall not be awarded at the close of the contest, and shall remain in the hands of the President, shall be used by him, as aforesaid, to further public speaking in the University, in any manner as he may see fit.

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking postgraduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty

may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded. The sum of one hundred and twenty-five dollars in the hands of the President to pay this prize, in the event of its not being awarded, as aforesaid, shall be used by him to further public speaking, as aforesaid, unless, however, he may consider that he has already a sufficient fund in his hands for that purpose. In this latter case, he shall use this above sum of one hundred and twenty-five dollars to encourage public debate in the University in any manner that he may see fit.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University; but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

## PRIZE OF THE PENNSYLVANIA SOCIETY OF NEW YORK.

The Pennsylvania Society of New York offers to Seniors of various Pennsylvania colleges, including Lehigh University, a prize of $100 for the best essay on a subject connected with the history of Pennsylvania.

# STUDENTS.

A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Clas.—Classical.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
L.S.—Latin-Scientific.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.
Phys.—Physics.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year:

## GRADUATE STUDENTS.

| | For Degree. | Residence. |
|---|---|---|
| Charles Estell Dickerson, B.S., | M.S., | Mount Hermon, Mass. |
| Herbert Charles Dilliard, C.E., | M.S., | East Bangor. |
| Morris Wilber Garman, Met. E., | E.M., | Nanticoke. |
| Henry Kemmerling, C.E., | M.S., | Scranton. |
| Myron Jacob Luch, B.A. | M.A., | Macada. |
| Martin Shaaff Stockett, B.A., | M.A., | Tamaqua. |

## SENIOR CLASS.

| | Course. | Residence. |
|---|---|---|
| Richard Lattimer Adams, | C.E., | Harrisburg. |
| Howard Leffingwell Baldwin, | C.E., | Allentown. |
| Norman Zabriskie Ball, | C.E., | Whippany, N.J. |
| George Carlton Beck, | A.C., | Williamsport. |
| Luther Becker, | M.E., | Schuylkill Haven. |
| Sylvanus A. Becker, | C.E., | Nazareth. |
| Willard Lynn Bruner, | A.C., | Philadelphia. |
| George Wishard Butz, | C.E., | Schuylkill Haven. |
| Thomas Leo Cannon, | C.E., | Allentown. |
| Courtland F. Carrier, jr., | A.C., | Elmira, N.Y. |
| George F. Cassedy, | M.E., | Ashley. |

| | Course. | Residence. |
|---|---|---|
| César Castellanos, | C.E., | Comitan, Chiapas, Mex. |
| John Joseph Cort, | E.E., | Latrobe. |
| Chauncy Shackford Curtis, | M.E., | New Castle. |
| Paul Arnold Degener, | M.E., | New York, N.Y. |
| Alfred John Diefenderfer, | Clas., | Bethlehem. |
| Harry W. Eisenhart, | M.E., | York. |
| Louis Withers Evans, | M.E., | Pottstown. |
| Samuel Palmer Felix, | M.E., | Schuylkill Haven. |
| Samuel Randolph Fraim, | M.E., | Lancaster. |
| Arthur Frick, | M.E., | York. |
| Thomas K. Reed Gardner, | C.E., | Egg Harbor City, N.J. |
| Paul Gerhard, | M.E., | East Orange, N.J. |
| Walter David Gernet, | C.E., | Nazareth. |
| Arthur Simon Gilmore, | Clas., | Williamsport. |
| Louis Tracy Girdler, | M.E., | Jeffersonville, Ind. |
| Alfred Robinson Glancy, | M.E., | Washington, D.C. |
| Solomon W. Goldschmidt, | E.E., | Mount Carmel. |
| George Kendrick Goodwin, | M.E., | Philadelphia. |
| Chester B. Graham, | E.E., | Washington, D.C. |
| Hugh Whitman Haynes, | C.E., | Allentown. |
| Nicholas Hunter Heck, | Clas., | South Bethlehem. |
| John Walter Hertzler, | M.E., | Lancaster. |
| Charles Frederick Hinckle, jr., | E.E., | Ardmore. |
| Raymond Hunt, | E.E., | Stockton, N.J. |
| Harvey Ernest Jordan, | Clas., | Coopersburg. |
| Willis Robert Jordan, | C.E., | Bangor. |
| George Maisch Kennedy, | E.E., | Pottsville. |
| George Murray Lewis, | C.E., | Seneca Falls, N.Y. |
| Canby Guy Lord, | Clas., | Williamsport. |
| Charles Edwin Marks, | E.E., | Sound Beach, Conn. |
| Emory Thompson Miller, | E.M., | Louisville, Ky. |
| Elias Robins Morgan, | M.E., | Wilkes-Barre. |
| William Henry Myers, | M.E., | York. |
| Archibald Ernest Olpp, | A.C., | Bethlehem. |
| Elmer Clinton Pearson, | Clas., | Siegfried. |
| Paul Peter Reese, | E.M., | Harrisburg. |
| John Routt Reigart, | E.M., | Washington, D.C. |
| Nathan Bennett Robbinovitz, | E.E., | Brooklyn, N.Y. |
| John Dwight Rogers, | C.E., | Remsenburg, N.Y. |
| Vicente Saucedo, | C.E., | Saltillo, Mex. |
| Francis Rauch Schmid, | C.E., | Bethlehem. |
| Royer Newton Skillman, | E.E., | Mount Healthy, O. |

| | Course. | Residence. |
|---|---|---|
| Dyer Smith, | M.E., | Washington, D.C. |
| David Robert Smith, | M.E., | Pittsburg. |
| Thomas K. Smith, | Clas., | Richland Centre. |
| Oran Charles Snyder, | M.E., | Bethlehem. |
| Arthur Vall Spinosa, | C.E., | San Juan, Porto Rico. |
| George Rosebery Stull, | Clas., | Ridley Park. |
| John Heckewelder Traeger, | C.E., | Bethlehem. |
| Henry Roscoe Trumbower, | Clas., | Passer. |
| Whitmell P. Tunstall, | C.E., | Washington, D.C. |
| Bowdewine Bertrand VanSickle, | L.S., | Unionville, N.Y. |
| Marcus Acheson Walker, | M.E., | Washington, D.C. |
| Henry R. Walters, | C.E., | Los Angeles, Cal. |
| George J. Walz, | E.E., | Harrisburg. |
| Newton Amos Wolcott, | E.E., | Farmington, O. |

## JUNIOR CLASS.

| | Course. | Residence. |
|---|---|---|
| George Baily, | C.E., | Baltimore, Md. |
| Harvey Pettibone Barnard, | A.C., | Washington, D.C. |
| Charles Greene Baumgartner, | M.E., | Asbury Park, N.J. |
| Howard Green Bayles, | Met., | East Orange, N.J. |
| Jacob Lynford Beaver, | E.E., | Phoenixville. |
| Warren Riegel Bell, | A.C., | Harrisburg. |
| Lester Bernstein, | C.E., | Philadelphia. |
| Robert Conner Bird, | E.E., | Weatherly. |
| Clinton Joel Bloss, | M.E., | Slatedale. |
| Harold Grant Bonner, | M.E., | Florida, N.Y. |
| Abraham George Borowsky, | E.E., | Philadelphia. |
| Gordon Hirsh Brandes, | E.E., | Philadelphia. |
| Jacob H. Brillhart, | C.E., | Loganville. |
| Edward Claude Brown, | E.E., | Lock Haven. |
| William S. Brownell, jr., | C.E., | Newport, R.I. |
| Algernon Raymond Burchsted, | M.E., | Wollaston, Mass. |
| Henry Freas Campbell, | C.E., | Williamsport. |
| John Jones Carl, | M.E., | Reading. |
| Samuel LeRoy Caum, | M.E., | Altoona. |
| Hiram Sanborn Chamberlain, jr., | E.M., | Chattanooga, Tenn. |
| Amos Henry Clauder, | C.E., | Bethlehem. |
| Horace Brooks Cleaveland, | E.E., | Washington, D.C. |

| | Course. | Residence. |
|---|---|---|
| Baxter Augustus Cornwell, | E.E., | Washington, D.C. |
| Milton Burnett Cory, | E.M., | Minneapolis, Minn. |
| Richard Sharpe Cunningham, | M.E., | Drifton. |
| Walter Hammer Cunningham, | M.E., | Johnstown. |
| John Dallas, | M.E., | Philadelphia. |
| Alexander Lardner Dornin, | M.E., | Norfolk, Va. |
| Emil August Droll, | M.E., | Plainfield, N.J. |
| William E. Dunbar, | C.E., | Harrisburg. |
| Harry Elias Edmonds, | C.E., | Elmira, N.Y. |
| Andrew Joseph Farabaugh, | E.M., | Altoona. |
| Louis Edward Farabaugh, | M.E., | Altoona. |
| John Warren Fisher, | C.E., | Williamsport. |
| William Warner Fitch, | A.C., | Rome, N.Y. |
| Charles Folsom, | E.M., | Biltmore, N.C. |
| Clarence J. Frederici, | C.E., | Auburn. |
| John Torrey Fuller, | E.M., | Wilkes-Barre. |
| J. Newlin Gawthrop, jr., | M.E., | Wilmington, Del. |
| Randolph Edward Spencer Geare, | M.E., | Washington, D.C. |
| Robert Stanley Goerlich, | Clas., | West Bethlehem. |
| John Jacob Grabe, | M.E., | Mitan, Russia. |
| Oliver Jacob Haller, | M.E., | Pittsburg. |
| Herbert Joseph Hartzog, | L.S., | South Bethlehem. |
| Carl Swing Heritage, | C.E., | Bridgeton, N.J. |
| Ray Livingston Herrick, | E.M., | Westfield, Mass. |
| Samuel Hess, | M.E., | Hellertown. |
| Jesse Bowman Hirst, | E.E., | Rosslyn, Va. |
| Samuel Henry Hodges, | M.E., | Norfolk, Va. |
| Frederick Gordon Hurst, | C.E., | South Bethlehem. |
| Robert Parke Hutchinson, | E.M., | Washington, D.C. |
| Henry Landon Jackson, | C.E., | Scranton. |
| Ralph Grant Johnson, | C.E., | Washington, D.C. |
| Michael Doland Jones, | C.E., | Rockaway, N.J. |
| Ramsey Daniel Kavanaugh, | M.E., | Williamsport. |
| Marcus Augustus Keck, | C.E., | Bethlehem. |
| Bert Moss Kent, | M.E., | Rome, N.Y. |
| Myron Hopkins Klar, | C.E., | Westfield, Mass. |
| Paul Theodore Krause, | A.C., | Bethlehem. |
| Ernest C. Laudenberger, | M.E., | Freemansburg. |
| Charles William Lüders, | L.S., | Philadelphia. |
| William Thurston MacCart, | C.E., | Williamsport. |
| Louis G. McCauley, | M.E., | Susquehanna. |

| | Course. | Residence. |
|---|---|---|
| John McCleary, jr., | C.E., | Germantown. |
| Frank James McDevitt, | M.E., | Lancaster. |
| Warren Courtland Macfarlane, | M.E., | Louisville, Ky. |
| Edgar M. Mack, | C.E., | Indiana. |
| Harry Cuthbertson Marshall, | M.E., | Allegheny. |
| José M. Mendoza, | M.E., | Lima, Peru. |
| Edwin Dewilla Merkel, | M.E., | Reading. |
| George S. Messinger, | M.E., | Tatamy. |
| John Meredith Miller, | C.E., | Sewickley. |
| Theodore Kühne Minsker, | C.E., | York. |
| Charles Newton Moffatt, | M.E., | Pittston. |
| John Meiklejohn Monie, | C.E., | Pittston. |
| Thomas Archie Morgan, | Clas., | Scranton. |
| Clarence Rupert Morss, | L.S., | Scranton. |
| Leigh Merle Morss, | Clas., | Scranton. |
| Howard Mallet Prevost Murphy, | M.E., | Philadelphia. |
| William Updegraff Mussina, | M.E., | Williamsport. |
| Charles Leonard Orth, | E.E., | Washington, D.C. |
| Carleton Gage Owen, | E.M., | Elmira, N.Y. |
| Donald Julian Packer, | C.E., | Trenton, N.J. |
| Nicholas Calvin Pamplin, | M.E., | Norfolk, Va. |
| Charles Roland Peebles, | Met., | Ashland, Ky. |
| John Franklin Pelly, | M.E., | Philadelphia. |
| Horace Weiser Pfahler, | A.C., | Holyoke, Mass. |
| Harold S. Pierce, | M.E., | Philadelphia. |
| William Calland Pollitt, | C.E., | Philadelphia. |
| John Howell Powell, | M.E., | Freeland. |
| Harold Patterson Reno, | M.E., | Pittsburg. |
| Ivan Schaick Rice, | M.E., | Catonsville, Md. |
| Edmund Alex. deSchweinitz, | M.E., | Bethlehem. |
| Stanley Sylvester Seyfert, | E.E., | Strausstown. |
| Jonathan Emmett Sheesley, | L.S., | Penbrook. |
| Stewart Sumner Shive, | E.E., | York. |
| William Roy Shively, | M.E., | Philadelphia. |
| Marvin White Singer, | M.E., | South Bethlehem. |
| Francis Peirce Sinn, | E.M., | Germantown. |
| Walter Souder Slifer, | C.E., | Lansdale. |
| John Clayton Snyder, | C.E., | Harrisburg. |
| Edward Wiseman Sprague, | M.E., | South Bethlehem. |
| Crist Harvey Stevick, | M.E., | Harrisburg. |
| John Ledyard Talcott, | E.M., | Buffalo, N.Y. |

| | Course. | Residence. |
|---|---|---|
| Ralph Lucas Talley, | L.S., | Williamsport. |
| Jesse Wagener Underwood, | E.E., | Washington, D.C. |
| Hugh Gaston VanderVeer, | C.E., | Somerville, N.J. |
| Richard Wahle, | E.E., | Buffalo, N.Y. |
| Harry Samuel Walker, | M.E., | South Bethlehem. |
| Swinton Ball Waring, | C.E., | Charleston, S.C. |
| James Stewart Warr, | M.E., | Oneida, N.Y. |
| William Henry Welker, | A.C., | Red Hill. |
| Arthur James Weston, | Clas., | Scranton. |
| Emery Stone Whitney, jr., | C.E., | Bethlehem. |
| Ray Franklin Wunderly, | C.E., | Nazareth. |
| Charles Ernest Yost, | C.E., | Middletown. |

## SOPHOMORE CLASS.

| | Course. | Residence. |
|---|---|---|
| Charles Edward Aldinger, | M.E., | York. |
| Theodore Robison Angle, | E.E., | Danville. |
| William Aaron Bachman, | M.E., | South Bethlehem. |
| Harold Provost Balston, | M.E., | Flushing, L.I. |
| Wilson S. Barley, | C.E., | Steelton. |
| Walter Carl Benedict, | C.E., | Scranton. |
| Azzel Clark Bennett, | M.E., | Oneida, N.Y. |
| Ben Crandall Bentley, | C.E., | Jackson, O. |
| E. Crandall Bentley, | C.E., | Jackson, O. |
| John Daniel Berg, | M.E., | Pittsburg. |
| Lewis S. Birely, | C.E., | York Road, Md. |
| Allen Thomas Blake, | C.E., | Albion, N.Y. |
| Louis Frederick Blume, | E.E., | Philadelphia. |
| Robert Amos Boehringer, | C.E., | Reading. |
| Walter Emerson Brown, | C.E., | Mattituck, L.I. |
| Frank Horace Browning, | M.E., | Washington, D.C. |
| William Wentworth Brush, | C.E., | Washington, D.C. |
| Walter S. Buck, | E.E., | Harrisburg. |
| Charles Ely Butz, | E.E., | Allentown. |
| Niles Chapman, | M.E., | Bethlehem. |
| Morton Hazen Chase, | M.E., | Philadelphia. |
| Herbert Ashman Church, | C.E., | Washington, D.C. |
| Douglass Meeker Clawson, | E.E., | Mount Vernon, N.Y. |
| Arthur Stevenson Clay, | C.E., | Holmesburg. |

| | Course. | Residence. |
|---|---|---|
| Clarence Edward Clewell, | E.E., | Winston-Salem, N.C. |
| Paul Cloke, | E.E., | Trenton, N.J. |
| Arthur Basil Conner, | A.C., | Westfield, Mass. |
| Dean Corsa, | E.M., | Washington, D.C. |
| Joseph Frederick Cottrell, | M.E., | Danville. |
| Alfred Paul Davison, | E.E., | Cambra. |
| John Adlum Dent, | M.E., | Brookland. |
| John Cyrus Distler, | M.E., | Baltimore, Md. |
| Baird George Dow, | C.E., | Wilkes-Barre. |
| Arthur Edgar, | A.C., | Owego, N.Y. |
| William Raymond Ehlers, | E.E., | Baltimore, Md. |
| George Pryor Enke, | M.E., | Nanticoke. |
| William Lawrence Estes, jr., | L.S., | South Bethlehem. |
| Oliver Morris Evans, jr., | C.E., | Lansdale. |
| Marcus Martin Farley, | C.E., | Trenton, N.J. |
| Samuel Henry Fleming, | E.E., | Philadelphia. |
| Fred Fletcher, | M.E., | Columbia. |
| John Howard Ford, | M.E., | Pittsburg. |
| John Marvin Fouse, | E.M., | Pittsburg. |
| Nevin Elwell Funk, | E.E., | Bloomsburg. |
| Albert Wesley Gaumer, | C.E., | Trooper. |
| Thomas Bragg Gilliam, | M.E., | Petersburg, Va. |
| Edward Ralston Goldsborough, | C.E., | Frederick City, Md. |
| Roger Samuel Stockton Guerber, | C.E., | Bethlehem. |
| Yellott Fitzhugh Hardcastle, | E.E., | Easton, Md. |
| Nathaniel Cole Harrison, | M.E., | Petersburg, Va. |
| Rexford Archibald Harrower, | C.E., | Swarthmore. |
| Cameron Douglass Hayes, | E.E., | Ballston, Va. |
| Wilson Swartz Heckler, | C.E., | Lansdale. |
| Walter Hilleroy Henderson, | C.E., | Rockville, Md. |
| William Homer Hendricks, | Met., | Hummelstown. |
| Frank Anderson Henry, | Ch.E., | Annapolis, Md. |
| Nerias Henry, | E.E., | Seven Valleys. |
| Paul Henry Herman, | E.E., | Baltimore, Md. |
| William Corcoran Hill, | M.E., | Pittsburg. |
| Wiley Daniel Hodges, | M.E., | Wilson, N.C. |
| Robert Garnett Hodgkin, | L.S., | Falls Church, Va. |
| Henry William Hoeke, | M.E., | Washington, D.C. |
| George Cookman Hogg, | E.M., | Baltimore, Md. |
| Edward Holljes, | M.E., | Baltimore, Md. |
| Elmer B. Hostetter, | M.E., | Landis Valley. |

| | Course. | Residence. |
|---|---|---|
| J. G. Hunt Isert, | M.E., | Louisville, Ky. |
| Frank W. Jefferson, | M.E., | Chesapeake City, Md. |
| Earley McIlhenny Johnson, | E.M., | Steelton. |
| Fred A. Johnson, | E.E., | Bethlehem. |
| William Roland Johnston, | E.M., | Washington, D.C. |
| John Taggart Jones, | M.E., | New Castle. |
| Reverdy Hamlin Jones, | C.E., | Norfolk, Va. |
| Ray C. Kautz, | E.M., | Moweaqua, Ill. |
| Robert Alfred Kinne, | C.E., | South Windham, Conn. |
| Ralph G. Kirk, | Met., | Harrisburg. |
| William Corson Kline, | C.E., | North Wales. |
| Edward Knapp, | A.C., | East Orange, N.J. |
| Harry O. Koch, | C.E., | Tamaqua. |
| Ray H. Kressler, | M.E., | Allentown. |
| Michael Henry Kuryla, | M.E., | Elmira, N.Y. |
| J. Clinton Landefeld, | M.E., | Ashland. |
| Ralph Worrall Landmesser, | M.E., | Wilkes-Barre. |
| George W. Landrus, | E.M., | Wellsboro. |
| Will Henry Larkin, | M.E., | Butler. |
| Joseph Lough Larmour, | M.E., | Upper Falls, Md. |
| James Fulton Leonard, | C.E., | Salisbury, Md. |
| William Henry Lesser, | M.E., | Upper Lehigh. |
| John Calvin Little, jr., | C.E., | Parkton, Md. |
| Thomas Henry Lowery, | C.E., | Bernardsville, N.J. |
| George Omer Lundy, | E.M., | Williamsport. |
| William Henry Lynch, jr., | C.E., | Harrisburg. |
| Ray Hope McFetridge, | M.E., | Hokendauqua. |
| Roswell Silas McMullen, | C.E., | Carbondale. |
| James Joseph MacNamara, | A.C., | Oneida. |
| Wallace Martin, | Clas., | Paterson, N.J. |
| James Alexander Mease, | M.E., | Bethlehem. |
| Norman Nathaniel Merriman, | L.S., | South Bethlehem. |
| George Stickle Mervine, | E.E., | Philadelphia. |
| Thomas Benjamin Mickley, | E.E., | Balliettsville. |
| John Galt Miller, | M.E., | Lyons, Kas. |
| Willis Groff Moyer, | E.E., | Souderton. |
| Arthur Frederic Murray, | M.E., | Bethlehem. |
| Clarence H. Ohlwiler, | A.C., | Altoona. |
| Hugh Pigott Oram, | C.E., | Washington, D.C. |
| William Emrick Ostermaier, | M.E., | Pittsburg. |

| | Course. | Residence. |
|---|---|---|
| Willard Marsh Payne, | A.C., | Elmira, N.Y. |
| Nathaniel Ramsay Pennypacker, | E.M., | Haddonfield, N.J. |
| Harry Alexander Peyton, | E.M., | Washington, D.C. |
| Earl Victor Phelps, | E.E., | Washington, D.C. |
| Cecil Walter Wm. Hugh Pocock, | E.M., | Bayonne, N.J. |
| Harry W. Protzeller, | E.E., | Hokendauqua. |
| Francis Rogers Pyne, | E.E., | Elizabeth, N.J. |
| Henry Bidlack Reed, jr., | M.E., | Milford. |
| Joseph Walker Reed, | M.E., | Meyersdale. |
| George Kunkel Reel, | Met., | Harrisburg. |
| Richard Roy Renner, | C.E., | Sharpsburg, Md. |
| Edwin Louis Rich, | E.E., | Washington, D.C. |
| William Henry Roberts, | C.E., | Bethlehem. |
| Richard Julian Roszel, | E.E., | Welbourne, Va. |
| John A. Ruddy, | C.E., | Scranton. |
| Francis C. Ryan, | Met., | Harrisburg. |
| Charles Edgar Ryder, | C.E., | Norristown. |
| Ray Philips Saffold, | E.M., | Washington, D.C. |
| Arnold Furman Sammis, | E.E., | Huntington, L.I. |
| John Peter Sanner, | M.E., | Frackville. |
| Clarence M. Saxman, | M.E., | Latrobe. |
| George Henry Schaeffer, | E.E., | Reading. |
| Frederick Charles Schlechter, | C.E., | Allentown. |
| Edgar Henry Schmidt, | C.E., | White Haven. |
| William Russell Schnabel, | C.E., | Bethlehem. |
| Harry Frederic Schuler, | E.E., | Salisbury, Md. |
| Alan deSchweinitz, | L.S., | Bethlehem. |
| James Alton Seacrest, | C.E., | Upton. |
| Horace Schultz Seipt, | C.E., | Worcester. |
| Oliver Paul Serfass, | E.E., | South Bethlehem. |
| Charles Augustus Shaffer, | M.E., | Harrisburg. |
| Joseph Shema, | C.E., | Baltimore, Md. |
| George Henry Shenberger, | M.E., | Manchester. |
| William Hershberger Shonk, | M.E., | Plymouth. |
| Clarence Simpson, | M.E., | Dover, N.J. |
| George Arthur Sisson, | C.E., | Big Rock, Ill. |
| George Madison Smartt, | M.E., | Chattanooga, Tenn. |
| Alfred Pollitt Smith, | C.E., | Baltimore, Md. |
| Richard Hendon Smith, | E.E., | Philadelphia. |
| Frank B. Snyder, | M.E., | Mount Joy. |
| Ned Herbert Snyder, | M.E., | Harrisburg. |

| | Course. | Residence. |
|---|---|---|
| Persifor Gybbon Spilsbury, | E.M., | Trenton, N.J. |
| Harold Tuttle Stearns, | M.E., | Wilkes-Barre. |
| Christian E. Stiver, | M.E., | Nazareth. |
| John Ellsworth Stonebraker, | E.E., | Hagerstown, Md. |
| George Levick Street, jr., | M.E., | Richmond, Va. |
| Heman Leigh Swift, | C.E., | Ishpeming, Mich. |
| Edward Russell Tattershall, | C.E., | White Haven. |
| Howell Harris Thomas, | M.E., | Baltimore, Md. |
| Percy Rutter Thomas, | M.E., | Wilkes-Barre. |
| Richard Ryland Thompson, | C.E., | Cape May, N.J. |
| Russell Raymond Throp, | M.E., | Trenton, N.J. |
| William S. von Borries, | E.M., | Louisville, Ky. |
| John Russell Wait, | M.E., | Roselle, N.J. |
| John Henley Walker, | C.E., | Walkerton, Va. |
| Adoniram Judson Warlow, | C.E., | South Bethlehem. |
| Edgar C. Weinsheimer, | E.M., | Allentown. |
| Harry Edward Weir, | E.M., | Philadelphia. |
| Clarence Bailey White, | A.C., | Philadelphia. |
| Albert Jones Willis, | C.E., | Philadelphia. |
| James Hunter Wily, | E.E., | Pughtown. |
| James Harold Wolfe, | M.E., | Philadelphia. |
| Edward Nicoll Woodbury, | C.E., | Middlesboro, Ky. |
| Charles Harold Young, | Clas., | Floyd, N.Y. |
| Albert Wright Zahniser, | M.E., | Mercer. |

## FRESHMAN CLASS.

| | Course. | Residence. |
|---|---|---|
| Edward Shultz Adams, | M.E., | Williamsport. |
| Geo. Herbert McKeand Adams, | C.E., | South Bethlehem. |
| William Drees Aiken, | C.E., | Bethlehem. |
| Sidney Arthur Alexander, | E.E., | Meriden, Conn. |
| David Wayland Andrews, | C.E., | Plantsville, Conn. |
| Addison Cooke Armstrong, | C.E., | Chicago, Ill. |
| Charles Luther Bachman, | M.E., | South Bethlehem. |
| Oliver Warren Badgley, | E.E., | Hackettstown, N.J. |
| Harlow Fredrick Banfield, | M.E., | Beaver. |
| Alfred Hennen Bannister, | E.E., | Reading. |
| Preston Albert Barba, | Clas., | Allentown. |

| | Course. | Residence. |
|---|---|---|
| William Mace-Douglas Barnes, | E.M., | Brooklyn, N.Y. |
| Calvin Barwis, | C.E., | Pittsburg. |
| Mead Reginald Beck, | Clas., | Bethlehem. |
| Norman Donald Benkhart, | E.M., | Philadelphia. |
| Francis Westwood Beverley, | E.E., | Winchester, Va. |
| Garnet Blocksidge, | E.E., | Pulaski, Va. |
| Edgar Ashton Borhek, | C.E., | Bethlehem. |
| Atherton Bowen, | E.E., | Pottsville. |
| David H. Brillhart, | C.E., | Loganville. |
| Aubrey Levis Broomall, | E.E., | Cheyney. |
| Joseph Anthony Buch, | E.E., | Santiago, Cuba. |
| Charles Francis Buckalew, | A.C., | Allentown. |
| Oscar Lindsay Bunting, | M.E., | Petersburg, Va. |
| Harvey Miller Burkey, | M.E., | Reading. |
| Cornelius Howard Burleigh, | E.M., | Colorado Springs, Col. |
| Paul Edmund Butler, | Ch.E., | Wilkes-Barre. |
| Bruce Bradford Buttler, | C.E., | Fort Niobrara, Neb. |
| Halsted Woodrow Caldwell, | E.M., | Greenwich, Conn. |
| Martin G. Chamaidán, | E.E., | Guayaquil, Ecuador. |
| Joseph Reed Chew, | C.E., | Millville, N.J. |
| Edwin Harding Clarke, | E.E., | Baltimore, Md. |
| Chester Philip Clingerman, | M.E., | Altoona. |
| Wharton Landis Cornell, | E.M., | Wilmington, Del. |
| Stewart Joseph Cort, | Met., | Allegheny. |
| John Noble Costello, | C.E., | Tacony. |
| William Walton Crawford, | E.E., | Richmond, Va. |
| John Summerfield Crowther, jr., | E.E., | Cockeysville, Md. |
| Alfred Warren Cupitt, | M.E., | Germantown. |
| Wallace Dann, | E.E., | Washington, D.C. |
| Hart Blayney Daugherty, | C.E., | Indiana. |
| Dion Kanouse Dean, | M.E., | Rahway, N.J. |
| Eugene Bromley DeMeritt, | M.E., | Exeter, N.H. |
| Clyde Denlinger, | C.E., | Strasburg. |
| Harry C. Dent, | M.E., | Allentown. |
| Charles B. Devlin, | E.E., | South Bethlehem. |
| Charles Victor Dietz, | E.M., | Lincoln, Neb. |
| Joseph Mason Dill, | E.M., | Bessemer, Ala. |
| Frank Leslie Dorr, | C.E., | Indiana. |
| Charles Dorrance, | E.M., | Dorranceton. |
| Robert Samuel Drummond, | M.E., | Philadelphia. |

| | Course. | Residence. |
|---|---|---|
| Wilton Adams Earnshaw, | E.M., | Lowville, N.Y. |
| Lewis George Eaton, | A.C., | Plainville, Conn. |
| Ralph Selden Edmondson, | C.E., | Titusville. |
| Henry Frederick Eigenbrodt, | C.E., | Baltimore, Md. |
| Morris de Bertholette Evans, | E.M., | Reisterstown, Md. |
| Walter French Evans, | C.E., | Beaver. |
| John Herbert Farrell, | E.M., | Gladstone, Mich. |
| Thomas George Fear, | M.E., | Eckley. |
| Raymond Lamur Filbert, | E.E., | Lebanon. |
| Arthur Coon Flory, | M.E., | Scranton. |
| Edward Staniford Foster, | Phys., | Bayhead, N.J. |
| Robert Carlton Fountaine, | Met., | Easton, Md. |
| Walter Edmund Frankenfield, | M.E., | Butztown. |
| Geo. Frederick Freudenberger, | M.E., | West Bethlehem. |
| Francis Henry Galvin, | E.M., | Jamacia Plains, Mass. |
| Claude Richard Geddes, | E.E., | Williamsport. |
| Edwin R. Geisewite, | C.E., | Reading. |
| Berkeley Willard Geyer, | C.E., | Washington, D.C. |
| Charles Frederick Gilmore, | Clas., | Williamsport. |
| Thomas Leslie Gossling, | E.E., | Philadelphia. |
| William Henry Grady, | E.M., | Rhone. |
| Augustine E. Greene, | M.E., | Bristol, Conn. |
| John H. C. Gregg, | C.E., | Catasauqua. |
| William Heyward Grimball, | E.E., | Charleston, S.C. |
| August Bernard Grubmeyer, | E.E., | Germantown. |
| Roberto Gutierrez, | C.E., | Serdo Durango, Mexico. |
| George LeRoy Hallock, | M.E., | Plainfield, N.J. |
| Edward Raymond Halton, | M.E., | Altoona. |
| William Seibert Hammaker, | E.E., | Harrisburg. |
| Edwin Paul Hayes, | M.E., | Eufaula, Ala. |
| Arthur Groff Hertzler, | M.E., | Lancaster. |
| Benjamin Hartley Hewit, | C.E., | Hollidaysburg. |
| James Allen Hoffman, | M.E., | Allentown. |
| Persifor Smith Holliday, | C.E., | Dover, Del. |
| Harlan Verne Honn, | E.E., | Washington, D.C. |
| Frederick Roland Horne, | C.E., | Plainfield, N.J. |
| Langdon Wright Howard, | E.E., | Plainfield, N.J. |
| Jesse Edwards Humphreys, | C.E., | Byberry. |
| Roger Hunt, | E.M., | Catasauqua. |
| William John Hutchinson, | A.C., | Englewood, N.J. |

| | Course. | Residence. |
|---|---|---|
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| Gilbert Garfield Jacobosky, | C.E., | Wilkes-Barre. |
| Clarence Arthur Jacoby, | E.E., | South Bethlehem. |
| John Richard James, | C.E., | Wilkes-Barre. |
| Howard William Jenkins, | C.E., | Steelton. |
| Benjamin M. Johns, | Clas., | Shickshinny. |
| Elmer C. Johns, | C.E., | McSherrystown. |
| Earle Frederick Johnson, | E.E., | Gracedale. |
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| William Newton Kelley, jr., | E.E., | Philadelphia. |
| Harry Edwin Kersburg, | E.M., | Medina, N.Y. |
| Milton Day Kirk, | E.M., | Curwensville. |
| George Edmund Kite, | C.E., | Norristown. |
| Philip Adolph Kober, | A.C., | Freedom. |
| Thomas Norman Lacey, | E.E., | Lititz. |
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| Clifford Barnes Langstroth, | M.E., | Rahway, N.J. |
| William Romeyn Lathrop, | M.E., | Seneca Falls, N.Y. |
| John Jay Leopold, | C.E., | Tamaqua. |
| Clayton Albert Lerch, | E.E., | Grantville. |
| Jacob Frank Lessig, | M.E., | Ashland. |
| Harry Oliver Lister, | E.M., | Carbondale. |
| Henry Johnson Lose, | E.E., | Williamsport. |
| Charles Wells Lotz, | M.E., | Reading. |
| Clair M. Loucks, | C.E., | York. |
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| William D. McCurdy, | M.E., | Grove City. |
| Edward James McMullin, | C.E., | Philadelphia. |
| Edward Marius McNally, | M.E., | South Bethlehem. |
| Gilbert Peters McNiff, | E.M., | Harrisburg. |
| J. Terence McVey, | C.E., | Ephrata. |
| Paul Donald March, | M.E., | Harrisburg. |
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| Leopoldo Mercader, | C.E., | Aguadilla, Porto Rico. |
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| Ernest Baldwin Miller, | E.E., | Westminster, Md. |
| Lloyd Owens Miller, | C.E., | Baltimore, Md. |
| Kenneth Mills, | C.E., | Washington, D.C. |
| Austin Wilford Moore, | E.E., | Scranton. |

| | Course. | Residence. |
|---|---|---|
| Isaac Hawkins Moore, | E.E., | Wilkes-Barre. |
| Ledlie Dominick Moore, | E.M., | Chatham, N.J. |
| Thomas Miller Myers, | E.E., | Baltimore, Md. |
| Frank Amandus Neff, | Clas., | Slatington. |
| Herbert Balderston Nelson, | E.E., | Philadelphia. |
| William Edward Nicholson, | C.E., | Elmira, N.Y. |
| Michael William Nolan, | M.E., | Carbondale. |
| Milton Cooper Pascoe, | C.E., | Coopersburg. |
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| Henry Stebbins Phillips, | E.M., | Lowville, N.Y. |
| William Dandridge Pinkerton, | E.M., | Baltimore, Md. |
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| John Thomas Rowe, | E.E., | Hampton, Va. |
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| Newton Guy Smith, | C.E., | Pottstown. |
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| Samuel Reuben Smith, | E.E., | South Bethlehem. |
| Judson Gray Smull, | A.C., | Altoona. |

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| Ellis Milton Spear, | E.E., | Baltimore, Md. |
| Jacob William Stair, | M.E., | York. |
| Howard Raymond Stocker, | C.E., | Reading. |
| Christian S. Stouffer, | E.E., | Sharpsburg, Md. |
| Samuel Strauss, | A.C., | South Bethlehem. |
| George Strobridge, | M.E., | New York, N.Y. |
| Elwood Melcher Taussig, | M.E., | Philadelphia. |
| Talbot Todd, | C.E., | Baltimore, Md. |
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| Frank Albert Vockrodt, | E.M., | Pittsburg. |
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| John Warren Watson, | M.E., | Wayne. |
| William Scott Watson, | M.E., | Williamsport. |
| Fred Eugene Westlake, | M.E., | New Castle. |
| William Allen Whaley, | M.E., | Norfolk, Va. |
| Charles Wheatley, | C.E., | Bethesda, Md. |
| Foster Reed Wheeler, | C.E., | Spencer, Mass. |
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| Samuel Porter Whiteside, | M.E., | Bell Buckle, Tenn. |
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| Edwin Clifford Williams, | C.E., | Washington, D.C. |
| Lee Porter Wray, | C.E., | Altoona. |
| Heaton Hobart Wright, | E.M., | New Haven, Conn. |
| Francis German Wrightson, jr., | M.E., | Easton, Md. |
| John James Young, jr., | C.E., | Williamsport. |

## SPECIAL STUDENTS.

| | Course. | Residence. |
|---|---|---|
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| Francis Marvin Bond, | M.E., | Baltimore, Md. |
| Willard Albert Deane, | Met., | Chicago, Ill. |
| Joseph Hornberger, | C.E., | Houston, Texas. |
| Walter Franklin Kern, | A.C., | Nazareth. |
| B. P. Lamberton, jr., | E.E., | Washington, D.C. |
| Charles Irwin Lattig, | L.S., | West Bethlehem. |
| Ross Dayton McCausland, | Met., | Chicago, Ill. |
| Lewis Deara Mayers, | A.C., | Kittanning. |
| William Wheeler Paul, | C.E., | Philadelphia. |
| Colden L'Hommedieu Ruggles, | M.E., | South Bethlehem. |
| Raymond John Spooner, | M.E., | East Aurora, N.Y. |

## SUMMARY OF STUDENTS BY CLASSES AND COURSES.

| | Graduates. | Seniors. | Juniors. | Sophomores. | Freshmen. | Specials. | Totals. |
|---|---|---|---|---|---|---|---|
| Classical | 2 | 9 | 4 | 2 | 7 | | 24 |
| Latin-Scientific | 1 | 1 | 5 | 4 | | 1 | 12 |
| Civil Engineering | 2 | 19 | 32 | 49 | 54 | 2 | 158 |
| Mechanical Engineer. | | 20 | 44 | 56 | 57 | 3 | 180 |
| Mining Engineering | 1 | 3 | 10 | 16 | 27 | | 57 |
| Metallurgical Eng | | | 2 | 4 | 4 | 3 | 13 |
| Electrical Engineering | | 11 | 13 | 31 | 49 | 1 | 105 |
| Analytical Chemistry. | | 4 | 6 | 7 | 10 | 2 | 29 |
| Chemical Engineering | | | | 1 | 1 | | 2 |
| Physics | | | | | 1 | | 1 |
| Totals | 6 | 67 | 116 | 170 | 210 | 12 | 581 |

## SUMMARY OF STUDENTS BY STATES.

| | |
|---|---|
| New Hampshire | 1 |
| Massachusetts | 8 |
| Rhode Island | 1 |
| Connecticut | 9 |
| New York | 37 |
| New Jersey | 37 |
| Pennsylvania | 340 |
| Delaware | 4 |
| Maryland | 40 |
| District of Columbia | 36 |
| Virginia | 19 |
| North Carolina | 3 |
| South Carolina | 2 |
| Kentucky | 7 |
| Tennessee | 4 |
| Alabama | 2 |
| Texas | 1 |
| Ohio | 4 |
| Indiana | 1 |
| Illinois | 5 |
| Michigan | 2 |
| Minnesota | 1 |
| Kansas | 2 |
| Nebraska | 2 |
| Colorado | 1 |
| Montana | 1 |
| California | 1 |
| Mexico | 4 |
| Cuba | 1 |
| Porto Rico | 2 |
| Ecuador | 1 |
| Peru | 1 |
| Russia | 1 |
| | 81 |

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Henry R. Price, C.E., M.D., Practicing Physician, 163 Hancock St., Brooklyn, N. Y.

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Frank Laurent Clerc, C.E., Mining Eng'r. Permanent address: Philipsburg, Pa.

* Deceased.

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Edward F. Fassitt, A.C., 153 E. Washington Lane, Germantown, Pa.

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Raymundo Floresta de Miranda, M.E., Division Eng'r, Rio de Janeiro and Northern R.R. Address: E. F. Principe de Grao Pará,Estacaodo Areal, Rio de Janeiro, Brazil.

James S. Polhemus, C.E., Asst. U. S. Eng'r, U. S. Eng'r's Office, Portland, Oregon.

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Tuck Ching Strong Yen, C.E., Imperial Chinese Ry. Administration, Canton-Hankow Line, Canton, China. Permanent address: Shanghai, China.

Arthur Reuben Young, C.E., with Fort Pitt Bridge Works, Pittsburg, Pa. Res: Canonsburg, Pa.

### CLASS OF 1902.

Frederic Arthur Armstrong, E.E., Asst. Mgr., Contract Dept., Brooklyn Edison Electric Illuminating Co., 360 Pearl St., Brooklyn, N.Y. Res: 249 President St.

Arthur Garfield Bachman, A.C., Chemist, with Ampere Electro-Chemical Co., Niagara Falls, N.Y.

Robert Montgomery Bird, M.E., with Bethlehem Steel Co., S. Bethlehem, Pa. Res: 433 Brodhead Ave.

William Taggart Carpenter, C.E., with U. S. Coast and Geodetic Survey. Permanent address: Pittston, Pa.

John Atkinson Cunningham E.E., 139 Main St., Henderson, Ky.

James Mitchell Daniel, jr., E.M., Subway Construction, New York, N. Y. Res: 512 Hancock St., Brooklyn, N.Y.

Alpha Albert Diefenderfer, A.C., Asst. in Chemistry, Lehigh University, S. Bethlehem, Pa. Res: 167 Chew St., Allentown, Pa.

James Nethermark Downey, E.E., with New Jersey Light, Heat & Power Co., 1509 Arch St., Philadelphia, Pa.

Edward Randolph Eichner, C.E., with F. A. Burdett, Consulting Engr, 7 E. 33rd St., New York, N. Y.

Henry LeRoy Fryer, C.E., Asst. to Supervisor, Philadelphia Yard, Pennsylvania R. R., 32nd St. and Powelton Ave., Philadelphia, Pa. Permanent address: 217 W. 4th St., Chester, Pa.

Castulo Gallardo, C.E., 24 Calle de la Compania, Guadalajara, Jalisco, Mexico.

John Thomas Gavan, C.E., Estimator for General Contractor, 1522 Prospect Ave., Scranton, Pa.

William Berger Geiser, B.S., Chemist with New York Central & Hudson River R. R., Albany, N.Y. Res: 613 Central Ave.

Peter William Gleason, M.E., Engineering Dept., New Castle Works of National Steel Co., New Castle, Pa. Res: 8 Beacon St.

Felix Golian, C.E., with Cambria Steel Co., Johnstown, Pa.

Charles Albert Gradwohl, A.C., Asst. in Chemical Laboratory, Bethlehem Steel Co., S. Bethlehem, Pa. Res: 30 W. 4th St.

Robert Franklin Gross, Met. E., Open Hearth Dept., Bethlehem Steel Co., S. Bethlehem, Pa. Res: Centre St., Bethlehem, Pa.

Maximilian Showzo Hachita, E.M., with Mexican Gulf Coal & Transportation Co., Howe, Ind. Ter.

William Rankin Hall, C.E., Draftsman, Phoenix Bridge Co., Phoenixville, Pa. Address: Box 683.

Walter Scott Hanna, C.E., Asst. in Civil Engineering, Massachusetts Institute of Technology, Boston, Mass. Res: 52 N. Beacon St., Allston, Mass.

John S. Hegeman, M.E., Crane Erecting, Morgan Engineering Co., 204 Main St., Alliance, O.

William Louis Heim, A.C., with National Electrolytic Co., Niagara Falls, N.Y. Res: 215 First St.

Foster Hewett, Met. E., Assistant in Metallurgy, Lehigh University, S. Bethlehem, Pa. Res: 66 Church St., Bethlehem, Pa.

Edwin Higgins, jr., E.M., with New Jersey Zinc Co., Joplin, Mo. Permanent address: 1400 K St., N.W., Washington D.C.

Albert Cass Hutchinson, C.E., with Waddell & Hedrick, Consulting Eng'rs, 1229 Locust St., Kansas City, Mo.

William Henry Jaxheimer, M.E., with the Morgan Engineering Co., 204 Main St., Alliance, Ohio.

Walter Scott Johns, jr., C.E., Rodman, Pennsylvania R. R. Co., Cresson, Pa. Res: Anderson House.

Charles Edgar Kendig, E.M., Mining Eng'r, McDowell, W. Va.

Walter Savage Landis, Met. E., Assistant in Metallurgy, Lehigh University, S. Bethlehem, Pa. Res: 48 Church St., Bethlehem, Pa.

Frederick Farrar Lines, Met. E., Bessemer Mill of the Maryland Steel Co., Sparrows Point, Md.

Myron Jacob Luch, B.A., Graduate Student at Lehigh University, S. Bethlehem, Pa. Res: Macada, Pa.

Johnson McVey, A.C., with Duquesne Iron Co., Pittsburg, Pa.

Elmer McClellan Milheim, E.E., Testing Dept., General Electric Co., Schenectady, N.Y. Res: 112 Barrett St.

William Lloyd Morgan, C.E., Chief Draftsman, Shawmut Mining Co., Brookville, Pa.

Charles Edwin Pugh Murray, C.E., Maintenance of Way Dept., Pennsylvania R. R., Columbus, Pa. Res: 549 Chestnut St.

Floyd Williams Parsons, E.M., with Stonewall Coal & Coke Co., Stonewall, W. Va.

William Frank Roberts, M.E., with Bethlehem Steel Co., S. Bethlehem, Pa.

Daniel Martin Sachs, jr., M.E., with Bethlehem Steel Co., S. Bethlehem, Pa. Res: 125 North St., Bethlehem, Pa.

Joseph Aiken Simons, E.E., with Keystone Telephone Co., 2nd and Sansom Sts., Philadelphia, Pa.

William Penn Slifer, C.E., with Rapid Transit Subway Construction Co., 13-21 Park Row Bldg., New York, N.Y. Res: Rutherford Villa, Rutherford, N.J.

Paul Helsel Smith, E.E., with Westinghouse Electric & Mfg. Co., Pittsburg, Pa. Res: 501 Hay St., Wilkinsburg, Pa.

Edmund Sewell Stevens, C.E., with Div. Eng'r, Baltimore & Ohio R. R., Baltimore, Md.

Richard Ferrier Taylor, E.E., Electrical Inspector, Bethlehem

Steel Co., S. Bethlehem, Pa. Res: 244 Market St., Bethlehem, Pa.

William Ernest Thomas, E.M., Mining Eng'r, with H. J. Hinterleitner, Spangler, Pa.

Robert William Thoroughgood, C. E., Asst. Eng'r, Staten Island Rapid Transit, Baltimore & Ohio R. R., New Brighton, Staten Island, N.Y.

The number of graduates is 1248, degrees having been conferred as follows:

Upon graduates of the School of General Literature: B.A., 55; B.S., 27; Ph.B., 7; M.A., 13.

Upon graduates of the School of Technology: C.E., 423; M.E., 271; B.S., 1; B.M., 19; B.S. (in Mining and Metallurgy), 112; E.M., 95; E.E., 175; A.C., 113; B. S. (in Architecture), 18; M.S., 12; Ph.D., 2; Met. E., 6.

Of these 12 have taken the degrees of B.A. and M.A.; 1 of B.S. and M.S.; 4 of B.S. and C.E.; 1 of B.S. and A.C.; 11 of B.M. and E.M.; 47 of B.S. and E.M.; 1 of B.S., B.M., and E.M.; 1 of B.M., E.M., and A.C.; 1 of B.S., E.M., and C.E.; 1 of C.E. and E.M.; 2 of A.C. and E.M.; 1 of M.E. and C.E.; 1 of M.E. and E.E.; 3 of C.E. and M.S.; 1 of E.E. and M.S.; 1 of M.E. and M.S.; 1 of A.C. and M.S.; 1 of B.S., E.M., and M.S., 2 of A.C., M.S., and Ph. D. 1073 graduates are still living.

## ONE YEAR COURSE IN ELECTRICITY.

Beginning with the year 1884-85, the University offered a special course in Electricity, covering one year's work. Those who completed this course received certificates, but no degrees. In 1888, the full four-year course in Physics and Electrical Engineering, leading to the degree of E.E., was established, and the one-year course was withdrawn. The names of those who completed this course are not included in the Roll of Alumni, but are here given:

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Albert Brodhead, '88, Real Estate, 121 S. Center St., Bethlehem, Pa.

Edward Conner, '86, 2206 Locust St., Philadelphia, Pa.

William Fairchild Dean, '88, Mgr., Montreal Office, Canadian General Electric Co., Ltd., 1802 Notre Dame St., Montreal, Can. Res: 1264 Dorchester St.

Horace Musser Engle, '86, Economic Geology and Mineralogy, 404 Terry Bldg., Roanoke, Va.

Herman Frauenthal, '88, A.C., M.D., Physician and Surgeon, 214 E. 50th St., New York, N.Y.

Walter George Fuller, '87, Electrician, Brattleboro, Vt.

John Wesley Hackney, '87, City Surveyor, of the firm of Ashmead & Hackney, Civil Eng'rs and Surveyors, Room 42, Real Estate and Law Bldg., Atlantic City, N.J.

James Arthur Heaton, '86.

Richard Otto Albert Heinrich, '88, Gen. Mgr., European Weston Electrical Instrument Co., Ritterstrasse 88, Berlin, Germany.

William Hoopes, '86, with the Pittsburg Reduction Co., Pittsburg, Pa. Res: cor. Bryant and Highland Aves.

Joseph Allison Horner, '88.

William Henry Hubbard, '88, 1026-1028 Filbert St., Philadelphia, Pa.

Walter Eugene Hyer, '86, College of Physicians and Surgeons, New York, N.Y. Res: 203 W. 87th St.

Daniel Henry Jenkins, '88, M.D., Physician, 1932 N. Main Ave., Scranton, Pa.

Charles Leavitt Jenness, '85, Sec. and Treas., The Avery & Jenness Co., 28 W. Washington St., Chicago, Ill. Res:5823 Madison Ave.

William Sigler Jones, '87, Sec. The Quaker City Electric Co., 237-239 Dock St., Philadelphia, Pa. Res: 5144 Wayne Ave.

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Robert McAllister Lloyd, '86, Pres., Electric Vehicle Co., 100 Broadway, New York, N.Y. Res: 9 E. 9th St.

Dion M. Martinez, jr., '87.

Charles Jacob Meade, '86, Edison Electric Illuminating Co.

Charles Jacob Miller, '88, Gen. Agt., New York Heat, Light, and Power Co., 1 Madison Ave., New York, N.Y. Res: 18 W. 21st St.

James Leidy Moore, '88, Supt., Electrical Dept., South Jersey Gas, Electric & Traction Co., Camden, N.J. Res: Moorestown, N.J.

George Harrison Neilson, '86, Supt., Braeburn Steel Co., Braeburn, Pa. Res: Oakmont, Pa.

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George Herbert Putnam, '85, Principal, Educational Dept., Kansas School for the Deaf, Olathe, Kan.

Charles Norris Robinson, '88, with the Choctaw, Oklahoma & Gulf R. R., Girard Bldg., Philadelphia, Pa.

Harry Meyer Seitzinger '88 Consulting Electrical Eng'r, 381 S. River St., Wilkes-Barre, Pa.

Arthur Douglas Spear, '87, Standard Carbon Co., Cleveland, O.

Lewis Buckley Stillwell, '85, Electrical Eng'r, Room 2503 Park Row Bldg., New York, N.Y. Res: Lakewood, N.J.

Charles Wesley White, '88.

George Henry Wolle, '87, Supt., Bethlehem Electric Light Co., Bethlehem, Pa.; Supt., Bethlehem & Nazareth Ry. Co.

Hugh Carlyle Young, '88, Second Lieutenant, Co. I, 28th U. S. V., Manila, P. I. Permanent address: Wellsboro, Tioga Co., Pa.

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J. F. Benson, '00.
S. E. Berger, '89.
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W. Bowie, '95.
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D

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W. R. Davis, '92.
W. S. Davis, '88.
W. H. Dean, '86.
C. H. Deans, '89.
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H. Denman, '92.
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C. E. Dickerson, '89.
E. Diebitsch, '89.
A. A. Diefenderfer, '02.
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P. E. Dinan, '97.
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E. Diven, '87.
L. Diven, '97.
E. Dodge, '92.
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T. M. Dodson, '00.
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T. J. Donahoe, '83.
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A. Doolittle, '87.
E. Doolittle, '91.
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W. J. Douglas, '94.
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E. H. Dutcher, jr., '96.
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A. Eavenson, '91.
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N. Eckert, '00.
H. Eckfeldt, '95.
J. J. Eckfeldt, '98.
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T. S. Eden, '96.
L. E. Edgar, '98.
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H. LeR. Fryer, '02.
F. P. Fuller, '93.
J. Fuller, '00.

W. B. Fuller, '98.
I. D. Fulmer, '97.

G

*G. L. Gabrio, '95.
L. L. Gadd, '94.
R. F. Gadd, '93.
A. G. Galan, '95.
J. M. G. Galán, '98.
C. Gallardo, '02.
F. M. Gallardo, '97.
J. G. Gandia, '99.
T. J. Gannon, '96.
M. W. Garman, '01.
H. M. Gassman, '01.
L. P. Gaston, '88.
W. Gates, jr., '88.
J. T. Gavan, '02.
C. W. Gearhart, '93.
F. B. Gearhart, '01.
W. B. Geiser, '02.
R. E. L. George, '98.
E. A. Giberga y Galé, '95.
J. J. Gibson, '95.
P. D. Giess, '97.
*J. E. Gilbert, '78.
A. H. Gill, '00.
T. M. Girdler, '01.
J. B. Given, '96.
T. Gjertsen, '92.
F. W. Glading, '94.
*A. M. Glassel, '77.
P. W. Gleason, '02.
*J. B. Glover, jr., '88.
E. G. Godshalk, '95.
H. H. Godshall, '93.
N. O. Goldsmith, '83.
F. Golian, '02.
O. S. Good, '97.
R. Goodman, '90.
W. T. Goodnow, '83.
W. R. Goss, '95.
R. C. Gotwald, '86.
E. G. Grace, '99.
J. W. Grace, jr., '99.
C. A. Gradwohl, '02.
*J. S. Graff, '96.
M. B. Graff, '94.
W. W. Graff, '01.
S. L. Graham, '93.
F. L. Grammer, '89.
W. Gratz, '98.
C. W. Gray, '81.
G. E. Greene, '90.
H. T. Greene, '00.
W. Griffith, '76.
J. S. Griggs, jr., '91.
E. A. Grissinger, '94.
R. S. Griswold, '97.
F. A. Groff, '00.
C. F. Gross, '00.
R. F. Gross, '02.
L. J. H. Grossart, '86.
W. H. Groverman, '96.
P. L. Grubb, '01.
W. B. Grubbe, '00.
*J. A. Gruver, '92.
W. Gummere, '99.
F. H. Gunsolus, '98.
B. Guthrie, '94.

H

W. N. Haas, '01.
M. S. Hachita, '02.
C. W. Haines, '74.
F. T. Haines, '95.
*H. S. Haines, '87.
J. F. Halbach, '75.
B. F. Haldeman, '81.
D. Hall, '96.
W. McC. Hall, '94.
W. R. Hall, '02.
F. D. Hallock, '94
T. G. Hamilton, '95.

M. S. Hanauer, '86.
W. T. Hanly, '97.
W. S. Hanna, '02.
*O. C. Hannum, '99.
A. B. Hanscom, '00.
H. Hardcastle, '88.
T. H. Hardcastle, '80.
W. G. Hare, '98.
S. T. Harleman, '01.
H. W. Harley, '90.
H. T. Harper, '84.
E. S. Harrar, '01.
G. W. Harris, '89.
L. S. Harris, '93.
G. A. Hart, '88.
W. D. Hartshorne, '74.
R. R. Harvey, '95.
S. J. Harwi, '86.
F. A. Hausman, '01.
G. S. Hayes, '91.
C. S. Haynes, '93.
R. Hazel, '98.
S. C. Hazelton, '86.
W. C. Hazlett, '78.
R. W. Heard, '93.
D. G. Hearne, '90.
R. C. H. Heck, '93.
J. S. Hegeman, '02.
I. A. Heikes, '85.
J. S. Heilig, '91.
W. L. Heim, '02.
W. A. Heindle, '91.
J. G. Heinz, '00.
G. M. Heller, '77.
L. Henderson, '89.
T. L. Henry, '95.
A. W. Henshaw, '94.
A. A. Herr, '74.
H. N. Herr, '96.
J. F. Hersh, '91.
H. B. Hershey, '98.
H. D. Hess, '96.
H. H. Hess, '98.
*H. S. Hess, '95.
A. Y. Hesse, '94.
C. E. Hesse, '89.
H. V. Hesse, '91.
F. Hewett, '02.
W. S. Hiester, '97.
I. M. Higbee, '95.
E. Higgins, '02.
H. H. Hillegass, '84.
F. H. Hilliard, '94.
E. D. Hillman, '98.
W. L. Hiss, jr., '95.
J. B. Hittell, '87.
J. D. Hoffman, '83.
E. F. Hofford, '84.
W. E. Holcombe, '94.
*J. S. B. Hollinshead, '90.
A. D. Hollingsworth, '00.
M. H. Holz, '94.
M. J. Honan, '00.
P. D. Honeyman, '91.
R. B. Honeyman, '88.
G. G. Hood, '83.
R. N. Hood, '97.
J. T. Hoover, '91.
C. C. Hopkins, '82.
W. Hopkins, '95.
G L. Hoppes, '83.
H. J. Horn, '98.
G. A. Horne, '99.
L. S. Horner, '98.
R. R. Hornor, '99.
H. S. Houskeeper, '72.
F. K. Houston, '90.
J. M. Howard, '87.
F. P. Howe, '78.
M. A. DeW. Howe, '86.
R. P. Howell, '96.
A. A. Howitz, '94.
C. W. Hudson, '89.
E. M. Huggins, '00.

G. W. Hunsicker, '94.
A. C. Hutchinson, '02.
G. C. Hutchinson, '94.

I

H. Ichikawa, '91.
*D. W. Irvine, '95.
H. T. Irwin, '97.

J

G. R. Jackson, '99.
W. S. Jackson, '96.
C. B. Jacobs, '95.
E. A. Jacoby, '95.
H. S. Jacoby, '77.
W. L. Jacoby, '92.
W. A. James, '95.
J. A. Jardine, '84.
H. S. Jaudon, '95.
W. H. Jaxheimer, '02.
S. H. Jencks, '88.
*G. A. Jenkins, '70.
A. P. Jenks, '97.
A. B. Jessup, '95.
A. E. Jessup, '92.
J. T. Jeter, '80.
J. J. Jimenez, '92.
E. B. John, '95.
W. S. Johns, '02.
A. T. Johnson, '99.
H. S. Johnson, '97.
V. A. Johnson, '96.
A. Johnston, '89.
A. B. Jones, '94.
B. H. Jones, '94.
C. C. Jones, '87.
H. H. Jones, '97.
A. E. Juhler, '91.
E. P. Jump, '01.
C. A. Junken, '86.

K

A. S. Kappella, '95.
D. Kautz, '95.
W. H. Kavanaugh, '94.
W. B. Keim, '95.
C. L. Keller, '93.
J. S. Kellogg, jr., '89.
J. W. Kellogg, '84.
H. Kemmerling, '91.
C. E. Kendig, '02.
J. M. S. Kerlin, '89.
D. G. Kerr, '84.
W. J. Kerr, '70.
E. A. Keys, '99.
H. E. Kiefer, '92.
W. F. Kiesel, jr., '87.
R. Kimball, '99.
C. F. King, '80.
H. E. Kip, '95
R. R. Kitchel, '92.
J. W. Kittrell, '87.
A. W. Klein, '99.
J. H. Klinck, '99.
V. W. Kline, '96.
*L. E. Klotz, '72.
H. M. Knapp, '91.
F. N. Kneas, '98.
R. W. Knight, '94.
F. H. Knorr, '87.
S. B. Knox, '93.
B. G. Kodjbanoff, '98.
J. deB. Kops, '83.
J. B. Krause, '98.
L. G. Krause, '01.
R. E. Kresge, '96.
W. V. Kulp, '90.
H. M. Kurtz, '90.

L

S. W. Labrot, '92.
D. H. Lackey, '95.
N. Lafon, '78.

P. A. Lambert, '83.
S. E. Lambert, '89.
W. A. Lambert, '95.
O. M. Lance, '72.
H. K. Landis, '90.
W. S. Landis, '02.
R S. Landron, '99.
C. A. Langdon, '94.
*S. D. Langdon, '87.
F. B. Langston, '84.
W. Langston, '84.
L. E. Lannan, '95.
G. L. de Lara, '86.
R. E. Laramy, '96.
W. A. Lathrop, '75.
S. T. Laubach, '01.
A. R. Laubenstein, '01.
F. C. Lauderburn, '91.
E. H. Lawall, '82.
J. P. S. Lawrance, '73.
T. H. Lawrence, '98.
J. W. Ledoux, '87.
L. R. Lee, '97.
H. Lefevre, '92.
J. E. Leibfried, '00.
G. C. Leidy, '00.
H. D. Leopold, '94.
C. McK. Leoser, jr., '91.
T. S. Leoser, '90.
W. G. Lessig, '00.
A. E. Lewis, jr., '88.
A. H. Lewis, '95.
G. Lewis, '95.
H. S. Lewis, '00.
T. Lewis, '97.
J. J. Lincoln, '89.
G. B. Linderman, '87.
R. P. Linderman, '84.
J. B. Lindsey, jr., '98.
F. F. Lines, '02.
A. E. Lister, '92.
J. E. Litch, '90.
F. J. Littell, '99.
J. E. Little, '94.
C. V. Livingston, '97.
W. J. Lloyd, '92.
J. Lockett, '89.
B. W. Loeb, '95.
F. S. Loeb, '93.
A. Long, '89.
A. F. Loomis, '97.
B. E. Loomis, '96.
C. A. Loomis, '98.
J. T. Loomis, '92.
W. Lord, '96.
T. P. Lovering, '95.
M. J. Luch, '02.
C. A. Luckenbach, '86.
C. O. Luckenbach, '94.
O. F. Luckenbach, '01.
T. W. Lukens, '00.
C. E. T. Lull, '00.
W. A. Lydon, '86.

M

J. B. MacBride, '96.
C. S. MacCalla, '96.
W. H. MacCarthy, '71.
W. T. McCarthy, '00.
H. D. McCaskey, '93.
H. H. McClintic, '88.
M. McClung, jr., '94.
J. A. McClurg, '91.
K. W. McComas, '00.
W. A. McFarland, '88.
C. W. Macfarlane, '76.
C. J. McGonigle, '01.
G. K. McGunnegle, '99.
H. L. McIlvain, '88.
R. A. McKee, '95.
C. L. McKenzie, '93.
F. A. McKenzie, '95.
S. T. McKenzie, '95.
O. G. MacKnight, '99.

B. MacNutt, '97.
J. D. McPherson, '94.
J. McVey, '02.
W. G. McVey, '00.
J. S. Mack, '88.
C. E. Maeder, '00.
R. W. Mahon, '76.
J. J. deG. Malcher, '76.
H. L. Manley, '92.
W. P. Marr, '93.
C. D. Marshall, '88.
L. H. Marshall, '98.
J. F. Marsteller, '77.
J. VanS. Martenis, '94.
C. E. Martinez, '01.
J. J. Martin, '89.
J. P. Martin, '00.
J. G. Mason, '97.
N. P. Massey, '95.
C. M. Masson, '99.
R. S. Masson, '92.
V. E. Masson, '96.
J. O. Mathewson, '94.
A. S. Maurice, '93.
C. F. Maurice, '95.
G. H. Maurice, '93.
A. E. Meaker, '75.
W. L. Meaker, '99.
W. A. Megraw, '97.
H. S. Meily, '87.
L. D. Menough, '01.
E. A. Mercenario, '97.
J. F. Merkle, '84.
F. A. Merrick, '91.
*W. S. Merrill, '94.
T. Merriman, '97.
T. Merritt, '74.
J. F. Middledith, '99.
E. McC. Milheim, '02.
E. J. Millar, '92.
Charles Henry Miller, '88.
*Charles Henry Miller, '89.
Charles Herbert Miller, '90.
E. F. Miller, '83.
E. W. Miller, '96.
G. P. Miller, '88.
J. E. Miller, '93.
J. S. Miller, '95.
J. Z. Miller, '91.
W. H. Miller, '94.
*J. H. Millholland, '88.
P. D. Millholland, '86.
H. S. Miner, '88.
H. B. de Miranda, '73.
R. F. de Miranda, '72.
*S. Miyahara, '77.
C. W. Moffett, '89.
C. A. Moore, '94.
H. J. Moore, '01.
M. de la Mora, '00.
R. de la Mora, '96.
W. F. More, '83.
C. H. Morgan, '96.
J. F. Morgan, '99.
W. L. Morgan, '02.
*C. F. Moritz, '98.
A. D. Morris, '95.
H. T. Morris, '91.
R. H. Morris, jr., '89.
W. E. Morris, '89.
J. Morrison, '75.
G. R. Morrow, '00.
H. S. Morrow, '88.
J. A. Morrow, '87.
J. T. Morrow, '89.
N. Morrow, '83.
R. T. Morrow, '82.
C. T. Mosman, '92.
D. L. Mott, '88.
F. D. Mount, '97.
E. T. Murphy, '01.
C. E. P. Murray, '02.
W. S. Murray, '95.
W. H. Mussey, '96.

H. K. Myers, '84.
J. H. Myers, '96.
W. F. Mylander, '93.

N

C. P. Nachod, '97.
G. Nauman, jr., '90.
W. L. Neill, '88.
R. Neilson, '95.
H. S. Neiman, '88.
J. L. Neufeld, '94.
C. W. F. Neuffer, '94.
R. E. Neumeyer, '90.
C. A. Newbaker, '94.
C. G. Newton, '99.
H. H. Newton, '97.
D. K. Nicholson, '85.
T. Nicholson, '83.
*H. B. C. Nitze, '87.
R. C. Noerr, '97.
J. T. Nolan, '01.
B. B. Nostrand, jr., '78.
A. R. Nuncio, '84.

O

J. A. de Obaldia, '98.
A. D. Oberly, '89.
F. Oberly, '96.
R. L. Ogden, '94.
J. F. O'Hearn, '94.
W. R. Okeson, '96.
C. L. Olmsted, '93.
L. A. Olney, '96.
R. B. Olney, '92.
J. M. O'Malley, '89.
C. J. O'Neill, '93.
G. Ordway, '94.
J. O'Reilly, '98.
H. Orth, jr., '92.
L. Ortner, '00.
N. M. Osborne, jr., '93.
R. E. Ozias, '92.

P

J. W. Packard, '84.
*H. E. Packer, '70.
H. C. Paddock, '98.
*J. H. Paddock, '79.
P. M. Paine, '91.
*H. Palmer, '88.
H. L. Palmer, '96.
*H. R. Palmer, '99.
M. P. Paret, '78.
C. J. Parker, '88.
C. W. Parkhurst, '93.
A. R. Parsons, '00.
F. W. Parsons, '02.
D. W. Patterson, '93.
G. S. Patterson, '83.
W. A. Payne, '94.
R. R. Peale, '83.
E. J. Peck, '01.
*H. R. Peck, '97.
J. G. Peck, '93.
F. S. Pecke, '75.
J. H. Pennington, '97.
W. C. Perkins, '90.
F. A. Perley, '98.
R. S. Perry, '88.
*F. B. Petersen, '85.
J. G. Petrikin, '96.
G. F. Pettinos, '87.
J. R. Pettit, '99.
W. V. Pettit, '94.
J. H. Philips, '95.
A. E. Phillips, '90.
J. Phillips, jr., '95.
R. H. Phillips, '87.
F. W. B. Pile, '88.
C. Platt, '90.
J. S. Polhemus, '72.
*R. K. Polk, '87.
C. P. Pollak, '87.
M. W. Pool, '96.
H. F. J. Porter, '78.

R. H. E. Porter, '89.
H. A. Porterfield, '83.
A. Potter, '90.
G. E. Potter, '80.
S. C. Potts, '94.
J. L. Poultney, '95.
N. S. Powell, '00.
E. W. Pratt, '90.
M. D. Pratt, '87.
H. R. Price, '70.
J. B. Price, '85.
E. J. Prindle, '90.
F. H. Purnell, '83.
M. H. Putnam, '97.

Q

C. W. Quarrier, '98.
E. A. Quier, '91.
H. C. Quigley, '95.

R

L. T. Rainey, '99.
F. DeW. Randolph, '92.
R. B. F. Randolph, '93.
W. K. Randolph, '78.
*J. L. Rankin, '96.
R. S. Rathbun, '92.
A. G. Rau, '88.
C. R. Rauch, '77.
C. E. Raynor, '88.
R. H. Read, '78.
J. J. Reamer, '00.
V. C. Records, '98.
H. B. Reed, '70.
H. P. Reed, '96.
Percy Lawrence Reed, '98.
Percy Leslie Reed, '99.
W. M. Rees, '74.
A. K. Reese, '89.
J. N. Resse, '00.
*A. S. Reeves, '84.
H. A. Reid, '96.
J. G. Reid, '93.
V. H. Reid, '99.
W. Reinecke, jr., '95.
E. T. Reisler, '87.
H. G. Reist, '86.
W. F. Rench, '91.
J. W. Reno, '83.
E. C. Reynolds, '93.
J. P. Reynolds, jr., '97.
S. A. Rhodes, '92.
W. P. Rice, '76.
F. E. Richards, '93.
G. T. Richards, '87.
H. Richards, '76.
J. W. Richards, '86.
L. W. Richards, '76.
W. P. Richards, '88.
*G. M. Richardson, '86.
O. Rickert, '88.
E. Ricksecker, '82.
W. C. Riddick, '90.
B. DeW. Riegel, '98.
J. I. Riegel, '92.
J. S. Riegel, '90.
S. S. Riegel, '97.
E. J. Rights, '95.
H. T. Rights, '95.
G. W. Ritchey, '93.
S. N. Riter, '95.
W. F. Roberts, '02.
*M. Rock, '69.
T. C. Roderick, '94.
W. H. Rodney, '01.
F. W. Roebling, jr., '01.
A. L. Rogers, '89.
C. L. Rogers, '83.
F. W. Roller, '94.
C. E. Ronaldson, '69.
*W. D. Ronaldson, '70.
D'A. W. Roper, '98.
*A. S. Ross, '86.
J. G. Ross, '00.

E. P. Roundey, '97.
*G. Rovelo, '99.
C. E. Rowe, '00.
H. W. Rowley, '85.
*C. W. Royce, '97.
*G. A. Ruddle, '86.
J. Ruddle, '83.
J. D. Ruff, '82.
G. H. Ruggles, '96.
C. B. Rutter, '94.
C. C. Rutter, '96.
J. C. Ryan, '01.

S

D. M. Sachs, '02.
F. B. Sage, '93.
A. L. Saltzman, '97.
J. E. Sanborn, '90.
A. Sanchez, '00.
A. J. Sanchez, '01.
R. F. Sanchez, '98.
C. F. Sanders, '97.
F. W. Sargent, '79.
E. T. Satchell, '00.
W. R. Sattler, '88.
*M. L. Saulsbury, '93.
A. C. Savidge, '01.
W. H. Sayre, jr., '86.
J. A. Schloss, '93.
R. Schmitz, '91.
E. A. Schnabel, '91.
A. Schneider, '92.
H. Schneider, '94.
B. F. Schomberg, '94.
A. Schotte, '93.
C. W. Schwartz, jr., '89.
H. C. Schewecke, '98.
E. Schwinghammer, '95.
C. F. Scott, '97.
H. H. Scovil, '00.
H. D. Scudder, '72.
W. McI. Scudder, '73.
*J. W. Scull, '87.
H. H. Seabrook, '97.
B. Searle, '84.
H. K. Seltzer, '95.
W. F. Semper, '93.
J. B. Semple, '92.
L. B. Semple, '84.
S. P. Senior, '97.
A. H. Serrell, '97.
J. C. Sesser, '96.
E. E. Seyfert, '94.
J. W. Shaeffer, '01.
*W. Shapleigh, '71.
A. B. Sharpe, '93.
F. B. Sheaffer, '97.
C. K. Shelby, '92.
L. R. Shellenberger, '91.
*A. Y. Shepherd, '96.
G. E. Shepherd, '94.
D. F. B. Shepp, '98.
J. L. Sheppard, jr., '97.
H. J. Sherman, '90.
J. E. Shero, '95.
A. Shimer, '99.
I. A. Shimer, '91.
C. E. Shipley, '94.
E. H. Shipman, '88.
W. C. Shoemaker, '90.
L. D. Showalter, '96.
H. Shriver, '96.
J. C. Shriver, '92.
J. S. Shultz, '00.
E. P. Shuman, '97.
*S. B. Sickler, '82.
J. S. Siebert, '86.
R. S. Siegel, '95.
E. H. Sigison, '95.
J. A. Simons, '02.
J. B. Slack, '95.
J. E. Slade, '97.
W. P. Slifer, '02.
A. P. Smith, '84.

*E. O. Smith, '85.
F. B. Smith, '97.
F. S. Smith, '87.
N. W. Smith, '93.
P. H. Smith, '02.
P. H. W. Smith, '92.
R. E. Smith, '94.
W. S. Smith, '00.
B. R. Smoot, '98.
A. M. Smyth, '89.
C. S. Snyder, '00.
E. E. Snyder, '87.
M. D. Sohon, '90.
E. A. Soleliac, '93.
A. Solorzano, '00.
F. P. Spalding, '80.
W. H. Speirs, '99.
J. H. Spengler, '86.
H. W. Sprague, '97.
M. T. Stack, '97.
E. S. Stackhouse, '86.
L. C. Starkey, '98.
W. P. Starkey, '00.
C. W. Startsman, '01.
H. S. Stauffer, '01.
*J. W. Stauffer, '98.
A. P. Steckel, '99.
E. G. Steinmetz, '95.
G. Stern, '93.
A. R. Sterner, '97.
E. S. Stevens, '02.
T. Stevens, '96.
W. Alonzo Stevenson, '88.
W. Alston Stevenson, '90.
J. Stewart, '97.
M. Stewart, '84.
H. T. Stilson, '91.
W. R. Stinemetz, '93.
C. H. Stinson, '83.
*R. Stinson, '83.
J. E. Stocker, '95.
A. W. Stockett, '89.
M. S. Stockett, '98.
L. Stockton, '81.
H. H. Stoek, '87.
W. H. Stokes, '88.
H. E. Stout, '86.
R. P. Stout, '91.
H. R. Stratford, '94.
P. B. Straub, '97.
R. M. Straub, '99.
T. A. Straub, '90.
J. A. Strauss, '00.
*J. K. Surls, '86.
W. C. Swartz, '94.
F. G. Sykes, '94.
E. H. Symington, '98.
J. F. Symington, '01.
T. H. Symington, '93.

T

J. E. Talmage, '91.
R. M. Tarleton, '95.
C. L. Taylor, '76.
E. S. Taylor, '96.
J. Taylor, '93
L. C. Taylor, '89.
R. F. Taylor, '02.
R. S. Taylor, '95.
W. B. Taylor, '96.
W. P. Taylor, '86.
*O. O. Terrell, '87.
*T. C. Thomas, '97.
W. E. Thomas, '02.
J. M. Thome, '70.
C. H. Thompson, '94.
F. duP. Thomson, '90.
J. A. Thomson, '96.
E. T. Thornton, '01.
R. W. Thoroughgood, '02.
A. T. Throop, '89.
N. Thurlow, '95.
E. C. Thurston, '96.
J. W. Thurston, '96.

H. A. Tobelmann, '00.
C. M. Tolman, '85.
C. C. Tomkinson, '90.
W. S. Topping, '91.
H. Toulmin, '86.
P. Toulmin, '86.
C. F. Townsend, '95.
J. B. Townsend, '95.
C. E. Trafton, '96.
L. B. Treharne, '80.
W. Treichler, '97.
H. C. Tripp, '96.
P. H. Trout, '94.
L. E. Troutman, '93.
O. W. Trueworthy, '94.
R. H. Tucker, '79.
Charles P. Turner, '89.
Clarence P. Turner, '94.
Claude A. P. Turner, '90.

U

W. F. Ulrich, '99.
G. G. Underhill, '01.
C. W. Underwood, '94.
W. E. Underwood, '97.
D. A. Usina, '91.
M. N. Usina, '92.

V

J. S. Van Alen, '01.
J. F. VanBenthem van den Bergh, '95.
A. H. Van Cleve, '90.
E. Vander Horst, '91.
H. R. Van Duyne, '97.
J. R. Van Duyne, '00.
B. R. Van Kirk, '80.
E. P. Van Kirk, '87.
W. R. Van Liew, '95.
C. H. Vansant, '95.
C. H. Veeder, '86.
J. S. Viehe, '99.
J. R. Villalon y Sanchez, '90.
J. D. Von Maur, '94.

W

*J. R. Wagner, '85.
C. P. Wagoner, '97.
C. Walker, '89.
L. W. Walker, '92.
R. W. Walker, '84.
J. S. Wallace, '96.
U. G. S. Walters, '96.
E. H. Waring, '98.
F. C. Warman, '93.
E. O. Warner, '94.
W. Warr, '95.
C. B. Warren, '98.
R. C. Warriner, '94.
S. D. Warriner, '90.
J. A. Watson, '84.
L. Watts, jr., '98.
*C. G. Weaver, '71.
H. S. Webb, '98.
W. M. Webb, '88.
C. E. Webster, jr., '98.
H. D. Webster, '96.
J. E. Weideman, '97.
F. A. Weihe, '89.
F. T. Weiler, '96.
W. E. Weimer, '89.
J. H. Wells, '85.
G. W. Welsh, '01.
G. E. Wendle, '91.
F. C. Wettlaufer, '99.
H. M. Wetzel, '88.
A. Weymouth, '94.
F. I. Wheeler, '95.
G. C. White, '97.
H. A. White, '95.
W. P. White, '00.
C. Whitehead, '85.
J. C. Whitmoyer, '95.
A. J. Wiechardt, '87.

E. N. Wigfall, '95.
H. A. Wilcox, '99.
H. A. J. Wilkens, '87.
E. B. Wilkinson, '01.
D. S. Williams, '96.
D. T. Williams, '90.
E. H. Williams, jr., '75.
*F. Williams, '87.
D. W. Wilson, jr., '96.
H. C. Wilson, '78.
H. D. Wilson, '01.
J. R. Wilson, '96.
J. M. Wilson, '95.
T. W. Wilson, '94.
W. L. Wilson, '88.
P. B. Winfree, '91.
E. B. Wiseman, '88.
D. H. Witmer, '92.
N. J. Witmer, '87.
F. Wittman, '92.
M. Wittmer, '82.
L. T. Wolle, '77.
C. O. Wood, '92.
G. H. Wood, '99.
H. L. Wood, '95.
T. B. Wood, '98.
H. R. Woodall, '89.
B. E. Woodcock, '92.
L. Wooden, '98.
W. B. Wooden, '94.
*H. Woods, '87.
*F. C. Wooten, '80.
A. M. Worstall, '96.
W. Worthington, '98.
E. A. Wright, '89.
H. Wright, '90.
J. B. Wright, '89.

Y

S. Yamaguchi, '88.
T. A. K. Yasharian, '00.
G. L. Yates, '97.
*R. B. Yates, '70.
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C. Yglesias, '95.
A. E. Yohn, '97.
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Z

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BETHLEHEM, PA.

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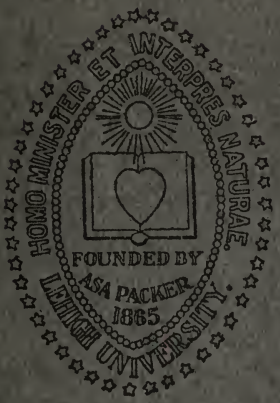
OF

# LEHIGH UNIVERSITY




## 1903-1904.

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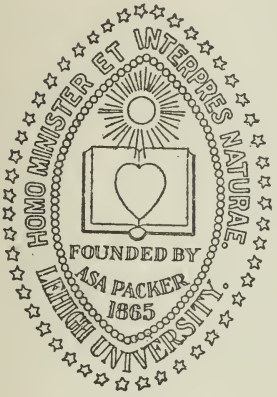
SOUTH BETHLEHEM, PA

# REGISTER

OF

# LEHIGH UNIVERSITY




## 1903-1904.

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SOUTH BETHLEHEM, PA.

# 1903.

## JULY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## AUGUST.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | ... | ... | ... | ... | ... |

## SEPTEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## OCTOBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| .. | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

## NOVEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## DECEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

# 1904.

## JANUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## FEBRUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## APRIL.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | .. | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| ... | ... | ... | ... | ... | ... | ... |

## MAY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JUNE.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JULY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | ... | ... | ... | ... | ... | ... |

## AUGUST.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## SEPTEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | .. |
| ... | ... | ... | ... | ... | ... | ... |

## OCTOBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | ... | ... | ... | ... | ... |

## NOVEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## DECEMBER.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| ... | ... | ... | ... | ... | ... | ... |

# 1905.

## JANUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## FEBRUARY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## MARCH.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## APRIL.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | ... | ... | ... | ... | ... | ... |

## MAY.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... |

## JUNE.

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | ... |
| ... | ... | ... | ... | ... | ... | ... |

## CALENDAR.

### 1903–1904.

| | |
|---|---|
| 1903. | |
| Sept. 19, 21, 22, | Examinations for Admission. |
| Sept. 23, 3.30 P.M., | First Term begins. |
| Oct. 8, | Founder's Day. |
| Nov. 25, 12.00 M., | Thanksgiving Recess begins. |
| Nov. 30, 8.15 A. M., | Thanksgiving Recess ends. |
| Dec. 23, 12.30 P. M., | Christmas Holidays begin. |
| 1904. | |
| Jan. 5, 8.15 A. M., | Christmas Holidays end. |
| Feb. 8, 8.15 A. M., | Second Term begins. |
| Feb. 22, | Junior Oratorical Contest. |
| March 30, 12.30 P. M., | Easter Holidays begin. |
| April 7, 7.45 A. M., | Easter Holidays end. |
| May 30, | Memorial Day (half holiday). |
| June 12, | Baccalaureate Sunday. |
| June 13, | Class Day. |
| June 14, | Alumni Day. |
| June 15, | University Day. |
| June 16, | Summer Term begins. |
| June 16, 17, 18, | Examinations for Admission. |

### 1904–1905.

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| 1904. | |
| Sept. 17, 19, 20, | Examinations for Admission. |
| Sept. 21, 3.30 P.M., | First Term begins. |
| Oct. 13, | Founder's Day. |
| Nov. 23, 12.00 M., | Thanksgiving Recess begins. |
| Nov. 28, 8.15 A. M., | Thanksgiving Recess ends. |
| Dec. 23, 12.30 P. M., | Christmas Holidays begin. |
| 1905. | |
| Jan. 5, 8.15 A. M., | Christmas Holidays end. |
| Feb. 6, 8.15 A.M., | Second Term begins. |
| June 14, | University Day. |

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# LEHIGH UNIVERSITY.

## ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

## DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Marine, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, Chemistry, Geology, Physics and in all needful collateral studies. A thoroughly equipped School of General Literature was also established, including the Classical and Latin-Scientific courses.

## SITE.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads, and the University buildings are about a half-mile from the station. New York is eighty-nine and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

## TUITION AND OTHER FEES.

For students in the courses of Civil, Mechanical, Marine, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, and Geology, the tuition fee is $150 for the year or $90 for either term; for students in the courses of Chemistry and of Physics, $100 for the year or $60 for either term; for students in the School of General Literature, $60 for the year or $40 for either term. A graduation fee of $10 must be paid by all candidates for a degree.

The special fees for materials and apparatus used in the various laboratories, etc., are given in connection with the description of the subjects under the List of Studies.

The tuition fees are payable to the Treasurer of the University in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $90, $60, or $40, according to the course, and the second $60, $40, or $20. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

## PUBLIC WORSHIP.

Morning prayers are held in the Packer Memorial Church of the University, at which attendance is required.

## BUILDINGS.

### PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem, West Bethlehem, and South Bethlehem.

The department of Civil Engineering occupies the greater part of the basement, first floor, and second floor of Packer Hall. In the basement are the testing laboratories for cement, brick and

metals, which contain four machines for tensile and compressive tests, one for torsion tests, and special apparatus for experimental work. On the first floor are two recitation rooms, a large drawing hall, three instrument rooms, two offices and a library room. On the second floor are two drawing rooms, two recitation rooms, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the departments of Mathematics and Modern Languages. The museum of Geology and Natural History is also on the third floor.

This building contains also the lecture and recitation rooms of the departments of Greek and Latin.

### THE CHEMICAL AND METALLURGICAL LABORATORY.

This is a thoroughly fire proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

Photographic and microscopical laboratories are located in the third story of the central portion of the building.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals; a museum for mineralogical and metallurgical collections; a mineralogical laboratory provided with a Fuess reflecting goniometer, Goldschmidt's "two-circle" reflecting and application goniometers, a polariscope, a Groth's "universal apparat," and a Rosenbusch polarizing microscope; a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. They are arranged for

the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

### THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY.

This building is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the two dynamo laboratories of the Electrical Engineering department, the work-shop, storage battery room, standardizing laboratory and six research rooms belonging jointly to the departments of Physics and Electrical Engineering.

The dynamo laboratory for Junior students in the east wing is supplied with power from an 8-horse-power steam engine and a 15-horse-power electric motor.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 50-horse-power steam engine. The dynamo laboratory equipment includes a 25 kilowatt double-current generator supplying both direct and alternating current, a Brackett cradle dynamometer, two 7½ kilowatt rotary converters, two arc light dynamos, twenty direct current dynamos and motors ranging from 1 horse-power to 15 horse-power, three alternators, including a 10 kilowatt Ferranti machine and a 5 kilowatt Westinghouse machine, twelve transformers from 1 to 5 kilowatts capacity, and a variety of instruments including voltmeters, ammeters, wattmeters, rheostats, contact makers, dynamometers, condensers, and other apparatus.

On the second floor are the offices of the departments of Physics and of Electrical Engineering, two general apparatus rooms, two large laboratory rooms for physics, including four photometer rooms, a drafting room and a seminary room for electrical engineering.

On the third floor are the physics lecture room, with apparatus rooms adjoining, photographic and photometer rooms, a recitation room, and a large audience hall.

On the fourth floor, well lighted by dormer windows and skylights, are four recitation rooms in the central portion of the

building, a large drawing room and a blue-print room in the east wing, and a large physical laboratory room in the west wing.

### STEAM ENGINEERING LABORATORY.

This is a new, well lighted, two story building of Potsdam sandstone, 90 feet long and 44 feet wide. It is divided into two sections, one for boilers and the other for engines. The former can accommodate three 100-horsepower high pressure boilers and the latter the various steam motors and their accessories. In this experimental power plant are contained a triple-expansion engine, a tandem-compound marine engine, a high-speed Ball engine (Erie, Pa.), coupled to a 25 K. W. Crocker-Wheeler generator, an Ingersoll-Sergeant Drill Co. air compressor which is compound at both air and steam ends, with reheating and cooling devices attached, and a DeLaval steam turbine that is combined with a centrifugal pump. The accessories are a Wilson-Snyder steam pump, a Blake pump, a Worthington circulating pump, a "Featherweight" air pump, a Cochrane feed-water heater and three Cochrane steam separators, also box-coil condensers, a Wheeler surface condenser, and Wainwright surface condenser. There is a complete set of Westinghouse air brake apparatus including the pump and engineer's valve, and several sets of the parts belonging to freight cars. In addition there are water meters, weighing tanks, and dynamometers for measuring the steam consumption and the development of power. Other experimental work is conducted in the basement of Williams Hall.

### WILLIAMS HALL.*

This building is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the department of Mechanical Engineering and the other half to Geology, Biology, and Mining Engineering.

In the eastern end are located the recitation rooms, instructors' offices, drawing rooms, reference library, and store rooms of the department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiences of

* Named for Prof. E. H. Williams, Jr.

hoisting and other gear, and the testing of motors and other prime movers than steam engines. In this section there are 4-cycle and 2-cycle gas engines, hot-air pumping engines, electric motors, a water motor, a 15-horsepower centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the department of Geology has on the first floor two lecture rooms, office, library, and laboratory of petrology. The larger of the two lecture rooms is fitted with collections of fossils, rocks, and economic minerals; the smaller room is equipped with stereopticon for illustrated lectures, and a study collection of rocks containing over two thousand specimens collected from the type regions in different parts of the world; the laboratory of petrology is provided with twelve high-grade petrographic microscopes, a micro-projection apparatus for lecture purposes, and study collections of rocks and thin sections. In the basement are rooms devoted to working collections and field equipment for Geology, and an apparatus for cutting thin sections of rocks, with a one horse-power motor for furnishing power.

The department of Mining Engineering has its office, library, and recitation rooms on the first floor, and a large room for illustrative material in the basement. The equipment for mine surveying includes a C. L. Berger & Son's complete mining transit with auxiliary top and side telescope and solar attachment, a Heller & Brightly 18-inch Y level with latest improvements, a monocular hand level, and other accessory instruments.

The department of Biology has its lecture room, store rooms, office, reference library, and laboratories on the second floor, and a large vivarium on the third floor. The laboratories of this department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

On the third floor of the building is located an assembly hall seating about 400.

### SAUCON HALL.

Extensive alterations to this building were made in 1896, adapting it to the needs of the departments of English and of History and Economics. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the Debating Society, with committee rooms adjoining.

### CHRISTMAS HALL.

In this building are found the drawing rooms of the Mining and Metallurgical departments and the halls of the Young Men's Christian Association. On the ground floor is a Supply Bureau conducted by students of the University.

### THE SAYRE OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt; and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

### THE PACKER MEMORIAL CHURCH.

The Packer Memorial Church is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent churches in the State.

### THE UNIVERSITY LIBRARY.

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than $20,000 was contributed by her family and friends as a memorial fund for the purchase of books.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied as a reading space, 50 by 40 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well lighted, and heated by steam.

One hundred and nineteen thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about four hundred, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

### The Eckley B. Coxe Memorial Library.

In memory of the Honorable Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe has presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

## THE GYMNASIUM.

The Gymnasium is a spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus and two handball courts, and is provided with hot and cold water, and shower baths, and 515 clothes closets.

## EXPENSES.

Books, stationery, and drawing instruments are provided by the student. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit or fee made at the opening of that term in which the laboratory work is to be done. These fees and deposits for the various laboratories are given under the detailed statement of laboratory courses in the List of Studies.

Rooms and board cannot be had in the University buildings, but can readily be obtained in many private houses in South Bethlehem and Bethlehem.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $350 to $500. This includes attendance at the required summer schools.

Information concerning scholarships and financial aid may be obtained from the Registrar.

*Fee for Special Examinations.*—Special examinations, granted by the Faculty to students at their request, are subject to a fee

of five dollars, which is added to the President's Fund for the aid of indigent students.

### DATE OF EXAMINATIONS.

Examinations for admission to the University will be held in 1904 on Thursday, Friday, and Saturday, June 16, 17, and 18, and on Saturday, Monday, and Tuesday, September 17, 19, and 20.

The examinations are held in June and September in the following order:

*First Day.*—Geometry, 8:00 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

*Second Day.*—Algebra, 8:00 A.M.; English, 2 P.M.

*Third Day.*—Trigonometry, 8:00 A.M.; American History, 11 A.M.; German or French, 2 P.M.; Greek and Greek History, 2 P.M.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 15. There will be an examination in Elementary Chemistry on September 21, 1904, at 8 A. M.; those passing this examination will take Stoichiometry during the first term.

Examinations are held for admission to the Sophomore Class at the beginning of the first term; information as to these examinations may be obtained from the Registrar.

The examinations cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his latest instructor.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

## THE SCHOOL OF GENERAL LITERATURE.

### THE CLASSICAL COURSE.

Candidates for admission to Classical Course are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of

sentences; and (*b*) *Rhetoric* and *Composition.* Any approved High School Rhetoric will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

*History.*—This requirement includes: (*a*) *Greek History* to the death of Alexander, with due reference to Greek life, literature, and art. (As in Botsford, Myers, or Oman, with Mahaffy's Old Greek Life); (*b*) *Roman History* to the accession of Commodus, with due reference to literature and government. (As in Myers's Rome or Allen's History of the Roman People, pp. 1-242, and in Preston and Dodge's Private Life of the Romans); (*c*) *American History,* with the elements of civil government. This includes colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Plane Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of metric units.

5. *Latin Grammar.*

6. *Caesar*, four books of the Gallic War.

7. *Cicero*, six orations, including the four against Catiline.

8. *Vergil*, the first six books of the Aeneid, including Prosody.

9. The translation, at sight, of passages from Caesar and Cicero.

10. The translation of English into Latin.

11. *Greek Grammar.*

12. *Xenophon*, Anabasis, four books.

13. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

14. The translation, at sight, of a passage from some work of Xenophon.

Candidates for admission to the Classical Course who have had, in their preparatory schools, no opportunity of studying Greek, are, at present, admitted to that course in full standing upon presenting in lieu of Greek an amount of German or French equivalent to two years' work. They will begin Greek in the Freshman year and study it throughout the course.

### THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first ten of the above requirements, but substitute for the Greek sections (numbers 11-14 inclusive) the following work:

15. *Solid Geometry.*

16. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

17. *German* or *French.* This requirement will be satisfied by the completion of an amount of German equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, and Buchheim's Reader, Part I, together with about 500 pages of standard German authors; or, if French is offered, an amount equivalent to Whitney's Practical Grammar and Super's Reader, together with about 800 pages of modern French authors. This requirement implies, in general, two years' academic work.

The candidate is expected to have acquired the ability to read German or French prose and poetry of ordinary difficulty. His proficiency will be tested by questions on Grammar, by translation of simple English sentences into German or French, and by translations at sight of passages containing no rare or unusual words.

## THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Marine Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, Electrical Engineering, Analytical Chemistry, Chemical Engineering, Geology, and Physics are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition.* Any approved High School Rhetoric will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *American History*, with the elements of civil government. This will include colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison

and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles. Solid geometry.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric units.

5. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

**All mathematical subjects should be thoroughly reviewed in the last year's work of the Preparatory school.**

6. *Elementary Physics.*—This requirement may be met by a good course in any of the standard High School text-books in Physics, such as Gage's Elements of Physics, Carhart and Chute's Physics, or Avery's Elements of Natural Philosophy. Ability to solve simple numerical problems is required. In case the candidate has done laboratory work in Physics he should submit his laboratory note book at the time of his examination for entrance.

7. *German.*—This requirement will be satisfied by the completion of an amount equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions on the rudiments of grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

### DIVISION OF EXAMINATIONS FOR ADMISSION.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June and the rest in September of the year of entrance, or may take them in *two consecutive years.* In the last case, for all courses candidates may present themselves for examination in the first

year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the Classical and Latin-Scientific Courses may present Latin: Grammar, Caesar, Cicero; and one of the following: (*a*) Greek: Grammar and three books of Anabasis; (*b*) German: the equivalent of one year's work; (c) French: the equivalent of one year's work.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

### ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class. The additional subjects may be found in the schedule of studies of the different departments.

A student from another College or University is admitted without entrance examinations, provided he has covered the entrance subjects required at this University. Evidence to that effect, together with a letter of honorable dismissal from his college, should first be filed with the Registrar. If these are satisfactory, the applicant will receive a certificate that the entrance requirements of this University are satisfied.

Applicants who have obtained this certificate and who desire to enter the Freshman or Sophomore class in February, must report personally to the Secretary of the Faculty on or before the Wednesday preceding the opening of the second term. Those who desire to enter the Sophomore or Junior class in September must report personally in June not later than the Thursday preceding University Day, or in September not later than the Thursday preceding the opening of the first term. For those applying after these dates an entrance fee of twenty-five dollars will be charged.

The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects already taken by the class that he desires to enter. It is necessary for an applicant to bring a certificate naming the

subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring samples of his drawings, field notes, computations and laboratory work for inspection and personal certificates from his teachers showing the grades attained at the college from which he comes. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may find it necessary to give a formal examination in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within three days from its date of issue. If all the subjects are accepted, the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

### ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Courses.

### PREPARATORY SCHOOL CERTIFICATES.

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations, and the acceptance of certificates for any student in any subject must be the result of a special arrangement between the Principal of the school and the Registrar of the University.

### EXAMINATIONS AT SCHOOLS.

When desired by the Principals, arrangements will be made to hold at the schools the June examinations for admission to the University. Such requests should be made before June 1st.

# LIST OF STUDIES.

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figure in parentheses. Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

## GRADUATE COURSES.

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any College or University, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases graduates of this University who are candidates for the degree of Master of Arts will be allowed to study in non-residence.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any College or University, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The tuition fee is $50 a year and the graduation fee is $10. No tuition is charged to students pursuing graduate work in non-residence, but the graduation fee is $30, and at least two years are required to complete the course.

The course of study may be selected, with the approval of the Faculty, from the following list of subjects, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department and about one-third in another, these being called major and minor departments. The thesis is to be prepared on a subject connected with the studies of the major department. The candidate is required

to satisfy each professor that he is fully competent to pursue the subjects selected.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

Candidates who desire to receive the Master's degree in June of 1905 are required to confer with the professors on or before September 24, 1904, and to present their courses of study to the Faculty for approval on September 26, 1904.

## IN SANITARY SCIENCE.

### The Mechanical, Chemical, and Biological Purification of Water and Sewage.

PRESIDENT DROWN.

A critical chemical and biological study of the results of recent investigations that have been carried on in Europe and in this country into the methods proposed and those in use for the removal or destruction of the organic and inorganic impurities of water and sewage. Two terms. (4)

## IN CHEMISTRY.

### Advanced Industrial Chemistry.

PROFESSOR CHANDLER.

This course involves the study of some industry dependent upon chemical principles and consists of practical experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms. (10)

### Advanced Organic Chemistry.

DR. SCHOBER.

This course consists of original investigations in organic chemistry. Two terms. (10)

### Advanced Inorganic Chemistry.

DR. ULLMANN.

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms. (10)

### The Rare Elements.

MR. BUCH.

The study of the properties and reactions of these elements and the preparation of some of their salts. Two terms. (10)

## IN MINERALOGY.

### Geometric Crystallography.

PROFESSOR FRAZIER.

An advanced course in mathematical crystallography, including practical instruction in the measurement, calculation, projection and drawing of crystals. Reference books: Mallard's Crystallographic Géométrique and Liebisch's Geometrische Krystallographie. First term. (5)

### Physical Crystallography.

PROFESSOR FRAZIER.

A description and discussion of the physical properties of crystals, with practical instruction in the determination of the optical constants of crystals. Reference books: Mallard's Crystallographie Physique, Liebisch's Physikalische Krystallographie, Groth's Physikalische Krystallographie. Second term. (5)

## IN CIVIL ENGINEERING.

### Bridge Design.

PROFESSOR MERRIMAN.

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparisons of different types. Two terms. (4)

### Testing of Materials.

PROFESSOR MERRIMAN.

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms. (5)

### Railroad Engineering.

PROFESSOR MERRIMAN.

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with the detailed discussion of special cases. Two terms. (2)

### Sanitary Engineering.

MR. ROGERS.

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms. (4)

## IN MODERN LANGUAGES.

### German.

PROFESSOR RINGER, MR. PALMER.

An advanced course in the German language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

### French.

PROFESSOR RINGER, ASSISTANT PROFESSOR GAUSS.

An advanced course in the French language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

## IN MATHEMATICS AND ASTRONOMY.

### Practical Astronomy.

PROFESSOR THORNBURG.

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longtitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms. (4)

### Analytical Mechanics.

ASSISTANT PROFESSOR MEAKER.

This course is based on Ziwet's Theoretical Mechanics and Routh's Dynamics of a System of Rigid Bodies. Two terms. (3)

### Differential Equations.

ASSISTANT PROFESSOR LAMBERT.

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms. (3)

## IN ENGLISH.

### English Literature.

PROFESSOR THAYER.

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms. (5)

## IN PHYSICS.

### Theoretical Physics.

PROFESSOR FRANKLIN.

This embraces: (*a*) The theory of heat, based upon Preston's Theory of Heat and Buckingham's Thermodynamics; (*b*) The theory of electricity and magnetism, based upon Maxwell's Treatise, J. J. Thomson's Recent Researches, and Webster's Electricity and Magnetism; or (*c*) The theory of light and sound, based upon Preston's Theory of Light and Helmholtz's Tonempfindungen. Two terms. (4)

### Physical Research.

PROFESSOR FRANKLIN.

This course consists of original investigations in experimental physics. Two terms. (3)

## IN HISTORY AND ECONOMICS.

### Political Economy.

PROFESSOR STEWART.

This course embraces: (*a*) The rise and development of economic systems and economic thought; (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn, and Ingram on Political Economy will be used. Two terms. (5)

### American History.

PROFESSOR STEWART.

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms. (5)

### Politics.

PROFESSOR STEWART.

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's History of the Science of Politics and Sidgwick's Element of Politics. Two terms. (5)

## IN LATIN.

### Roman Law.

PROFESSOR BLAKE.

(*a*) Roman law before Justinian: based on Bruns's Fontes Juris Romani Antiqui, and Mommsen's Abriss des römischen Staatsrechts. (*b*) Justinian's Institutes, Morey's Outlines of Roman Law, and collateral reading. Two terms. (4)

### Roman Philosophy.

PROFESSOR BLAKE.

(*a*) Cicero, De Legibus and De Natura Deorum; History of Roman Philosophy. (*b*) Selected readings from Seneca. Two terms. (3)

### Roman Literature.

PROFESSOR BLAKE.

(*a*) History of Roman literature. (*b*) Readings from Latin authors not previously read in course, as far as practicable paralleling the work in (*a*). Two terms. (3)

## IN GREEK.

### Hellenistic Greek.

PROFESSOR GOODWIN.

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms. (5)

### Dramatic Poetry.

PROFESSOR GOODWIN.

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms. (5)

### Greek Philosophy.

PROFESSOR GOODWIN.

Plato's Republic and other works. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms. (5)

## IN METALLURGY.

### Thermo-Chemistry and Thermodynamics of the Metals.

PROFESSOR RICHARDS AND MR. LANDIS.

A study of the melting points, boiling points, specific heats, and latent heats of fusion and of vaporization of the metals, from a practical and theoretical standpoint. Also, of the heat of formation of compounds of the metals, and the relations of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term. (5)

### Thermo-Chemistry and Physics of Metallic Alloys.

PROFESSOR RICHARDS, MR. LANDIS.

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heat of fusion, heats of formation and microscopic structure. Lectures and experimental work in the same. Second term. (5)

### Electro-Metallurgy.

PROFESSOR RICHARDS, MR. LANDIS.

A study of the conditions of deposition of pure metals in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term. (5)

## IN ELECTRICAL ENGINEERING.

### Theory of Alternating Currents and Alternating Current Machinery.

PROFESSOR ESTY.

This course is based upon the works of Bedell and Crehore, of Steinmetz, and of Franklin and Williamson. Two terms. (4)

### Electrical Design.

PROFESSOR ESTY.

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Design of special machines. Two terms. (3)

### Electrical Testing.

PROFESSOR ESTY AND MR. REGESTEIN.

This course consists of special experimental researches in electrical engineering. Two terms. (3)

## IN PHILOSOPHY AND PSYCHOLOGY.

### Psychology.

PROFESSOR WITMER.

An advanced course will be provided for graduate students who can furnish evidence of sufficient preparation.

## IN MINING ENGINEERING.

### Mining Methods.

ASSISTANT PROFESSOR ECKFELDT.

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method, and cost. Two terms. (3)

### Mining Plant.

ASSISTANT PROFESSOR ECKFELDT.

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms. (2)

### Dressing Plant.

ASSISTANT PROFESSOR ECKFELDT.

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of processes. Losses in dressing. Two terms. (2)

## IN GEOLOGY.

### Geology.

ASSISTANT PROFESSOR IRVING.

Field investigation and study of the literature of some special geological problem. This will comprise field and laboratory work

on some district in the vicinity of the University. A map of a limited area will be constructed, the microscopic character and general structural features of the rocks which are exposed will be investigated and a thesis or dissertation embodying these results will be presented. Preparation required will depend upon the nature of the problems to be studied. Two terms. (4)

### Economic Geology.

ASSISTANT PROFESSOR IRVING.

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student will be required to make a thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 254 or 255, also 252. First term. (6)

## IN BIOLOGY.

### Paleontology.

DR. HALL.

The study of the characteristic genera of fossil animals in detail, their structure, relationship, and geological range. Lectures and laboratory work. Preparation required: 272. 273 will be found advantageous.

### Vertebrate Embryology and Organology.

DR. HALL.

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, beginning with the segmentation of the egg and tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 272, 273, and 274. First term. (3)

## UNDERGRADUATE COURSES.

The University offers the following four year courses:

I. In the School of General Literature:
1. The Classical Course.
2. The Latin-Scientific Course.

II. In the School of Technology:
1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Marine Engineering.
4. The Course in Metallurgical Engineering.
5. The Course in Electrometallurgy.
6. The Course in Mining Engineering.
7. The Course in Electrical Engineering.
8. The Course in Chemistry.
9. The Course in Chemical Engineering.
10. The Course in Geology.
11. The Course in Physics.

These courses are described in detail on pages 74 to 118 of the Register.

### PHILOSOPHY AND PSYCHOLOGY.

PROFESSOR WITMER, MR. DAVIS.

1. History of Ancient and Medieval Philosophy. An outline of the rise and development of philosophy among the Greeks; the early formulation of the distinctive and fundamental conceptions of science, logic, ethics and psychology; a general characterization of the Neo-Platonic, Patristic, and Scholastic philosophy in relation to the institutions and culture of the times. Selected readings from typical philosophers of the period. First term. (2)

2. History of Modern Philosophy. The rise of modern philosophy and science following the Renaissance; their separate development in the succeeding periods; an examination of the systems of representative thinkers and of leading tendencies in recent European philosophy. Selected readings from British and other philosophic classics. Second term. (2)

3. Analytic Psychology. An introspective and experimental analysis of perception; the role of apperception, memory, atten-

tion, and association; the perception of space; the relation of perception to the sense organs and to the physical stimuli or objects of the environment. Lectures and laboratory work. First term. (2)

4. Physiological Psychology. The relation of mind and brain; the nature of voluntary, automatic and reflex movements; inherited instincts and acquired habits; impulse and emotion; sensation, memory, and imagination; the structure and functions of the human nervous system; dissection of the brain and experimentation upon voluntary and reflex movements. Lectures and laboratory work. Second term. (2)

5. Genetic Psychology. The development of the individual mind through the combination and organization of sensation and memory; the growth of habits from the conscious and voluntary modification of instincts; the general conditions affecting mental development and retardation in the individual; the biological factors of heredity and evolution determining the course of mental development in the lower animals and in man. Preparation required: 3 and 4. First and second terms. (2)

6. Experimental Psychology. Laboratory work on experimental problems selected in part to illustrate and supplement Course 5 and in part to meet the special needs of advanced students. Preparation required: 3 and 4. First and second terms. (1) or (2)

7. Pedagogy. The psychological basis of modern educational theory and practice. Intended to supplement Courses 3 and 4. Elective for students who are taking or have had these courses. First and second terms. (1)

8. History of Education. A brief history of educational institutions and theories, with special reference to their origin and derivation in connection with the development of philosophic systems and ideals of culture. Intended to supplement Courses 1 and 2, but may be elected independently. First and second terms. (1)

## ECONOMICS AND POLITICS.

PROFESSOR STEWART.

10. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

11. Economics. Practical economic problems: taxation, transportation, finance, labor, trusts and monopolies. Second term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

12. Economics. History of the industrial change in the 18th and 19th centuries, particularly the economic development of England and the United States. First term. (2)

13. Economics. Studies in the development of modern theories of economics. Second term. (2)

14. Politics. Constitutional Law. Studies in Federal and State constitutional law. Preparation required: 24, 25. First term. (2)

15. Politics. Comparative Constitutional Law. Studies of the English, German, and French political organizations. Preparation required: 14. Second term. (2)

## HISTORY.

PROFESSOR RINGER.

20. European History. Political History of Europe from Congress of Vienna, 1815, to Congress of Berlin, 1878. First and Second terms. (1)

PROFESSOR STEWART.

23. History. Europe and America in the 16th and 17th centuries. Growth of the British colonial interests. The War for American Independence. Second term. (2)

24. History. Formation of the Federal Constitution. Development of political parties. Economic progress of the country previous to 1860. The struggle over secession. First term. (2)

25. History. The United States since 1865. Effects of the war upon the economic and social life of the Union. The industrial expansion and its relation to political organization. Second term. (2)

## LANGUAGES.

### LATIN.

PROFESSOR BLAKE.

30. Livy. Selections from Books I, XXI, and XXII. Cicero, De Senectute, and De Amicitia. Particular attention to forms and the usages of normal syntax. Writing of Latin prose exercises based upon the selections read. Written translations

from Latin into English. History of the struggle between Rome and Carthage. First term. (4)

31. Horace. Odes and Epodes. Catullus. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Writing of brief original dissertations on topics assigned in connection with Horace. Historical review of Roman lyric and elegiac poetry. Second term. (4)

32. Pliny. Selected letters. Tacitus. Agricola and Germania. Latin prose composition based upon epistolary models. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. First term. (3)

33. Plautus and Terence. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Second term. (3)

34. Horace. Selected Satires and Epistles, and Ars Poetica. Consideration of the philosophy and literary art of Horace. Second term. (2)

35. Tacitus. Selections from the Histories and Annals. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. First term. (3)

36. Juvenal. Selected Satires. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Second term. (3)

37. Lucretius. Careful study of one book entire of De Rerum Natura, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. First term. (3)

38. Roman Law. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's Outlines of Roman Law. Second term. (3)

## GREEK.

### PROFESSOR GOODWIN.

40. Xenophon. Oeconomicus or Hellenica. Review of the Grammar. Prose Composition. Sight-reading. Attic prose syn-

tax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. One hour a week is devoted to composition and a variety of practical exercises. First term. (4)

41. Herodotus. One book, with sight-reading. Grammar and Composition. Study of the forms and syntax of the Ionic Dialect. Practical exercises continued. Second term. (4)

42. Lysias. Selected Orations. Prose syntax. Practical exercises, including composition, are given once in two weeks. First term. (3)

43. Euripides. Alcestis, Hippolytus, or Bacchae. Plato. Euthyphro, or Apology. Literary study of the drama and of Plato. Poetical language, style, and conception. Metres. Introduction to Greek Philosophy. Composition continued. Second term. (3)

44. Thucydides. One book; or Demosthenes. Selected Orations. Second term. (2)

45. Sophocles. Oedipus Tyrannus, Antigone, or Philoctetes. Aeschylus. Agamemnon, or Prometheus Bound. Literary study of the drama continued. Practice in metrical reading. Text-criticism. First term. (3)

46. Plato. Selected shorter dialogues. Plato as philosopher and literary artist. Second term. (3)

47. Aristophanes. Clouds, Frogs, or Birds. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. First term. (3)

48. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar, or Theocritus. Study of the development of poetry in Greece. Second term. (3)

49. Hellenistic Greek. New Testament. Selections from Lucian. To be substituted on occasion for 48. Second term. (3)

## FRENCH.

PROFESSOR RINGER,

ASSISTANT PROFESSOR GAUSS, MR. PALMER, MR. STIDMAN.

60. Elementary French. Whitney's French Grammar. Kuhn's French Reader. First term. (2)

61. Elementary French, Continued. Grammar and Reader. Dictation. Reading of short stories from different authors. Second term. (2)

62. FRENCH. More advanced work in the Grammar. Reading of Le Cachet Rouge, deVigny; Sans Famille, Malet; La Mare au Diable, George Sand. Dictation. First term. (3)

63. FRENCH. Selections from modern authors and readings from Molière, Corneille, and Racine. Dictation. Second term. (3)

(Courses 62 and 63 are for Freshman year of those who entered on French.)

64. FRENCH. French Composition. Dictation. Translation from English into French. Thorough study of several tragedies by Racine and Corneille. First term. (2)

65. FRENCH. Lectures on French Literature based on Brunetière's Manuel de l'Histoire de la Littérature Française. Selections from Victor Hugo, Lamartine, deMusset, and the modern historians. Second term. (2)

66. FRENCH. Historical Grammar. Darmstetter's History of the French Language. Composition. First term. (2)

67. FRENCH. Lectures in French on the literature of the 18th century, with special reference to the Encyclopedists. Composition. Second term. (2)

68. FRENCH. Lectures in French on the French Dramatists up to the Romantic School. First term. (2)

69. FRENCH. Lectures in French on the Historians of the 19th century and the Dramatists of the Romantic School. Second term. (2)

Courses 67 and 69 will be given in alternate years.

An optional course in French conversation is open to students of all classes. (1)

## GERMAN.

PROFESSOR RINGER,

ASSISTANT PROFESSOR GAUSS, MR. PALMER, MR. STIDMAN.

70. ELEMENTARY GERMAN. Joynes-Meissner's Grammar. Joynes's German Reader. First term. (2)

71. ELEMENTARY GERMAN, CONTINUED. Joynes-Meissner's Grammar. Dictation. Reading of short stories from different authors. Second term. (2)

72. GERMAN. More advanced work in the Grammar. Dictation. Reading of more difficult German prose. First term. (3)

73. GERMAN. Continuation of course 72. Reading of Freytag's Aus dem Staat Friedrichs des Grossen, and some of the masterpieces of Lessing, Schiller, and Goethe. Second term. (3)

(Courses 72 and 73 are for Freshman year of those who entered on German.)

74. GERMAN. Jageman's Prose Composition. Dictation. Translation from English into German. Reading of the dramatic masterpieces of Lessing, Schiller, and Goethe, and the poems of Heine. First term. (2)

75. GERMAN. Lectures on German Literature based on Scherer's History of German Literature. Original compositions. Reading of German Classics. First term. (2)

76. ADVANCED GERMAN. Advanced Grammar. History of the German Language. Composition. First term. (2)

77. GERMAN. Lectures in German on the Dramatists and Historians of the 19th century. Second term. (2)

78. GERMAN. Lectures in German on Lessing and Herder. First term. (2)

79. GERMAN. Lectures in German on Schiller and Goethe. Second term. (2)

Courses 77 and 79 will be given in alternate years.

An optional course in German conversation is open to students of all classes. (1)

## SPANISH.

ASSISTANT PROFESSOR GAUSS.

80. (Elective.) ELEMENTARY SPANISH. Loiseaux's Spanish Grammar. Reading of easy modern Spanish. Dictation. Drill in Spanish conversation. First term. (2)

81. (Elective.) ELEMENTARY SPANISH, CONTINUED. Continuation of course 80. Reading of more difficult Spanish. Writing of short themes and practice in talking Spanish. Second term. (2)

The courses in Spanish are open to all students of the University, but cannot be accepted as the equivalent of French or German.

## ITALIAN.

ASSISTANT PROFESSOR GAUSS.

85. ITALIAN. A brief study of Grandgent's Italian Grammar. Drill in writing exercises and use of elementary Italian. Reading of easy texts, stories of D'Amicis and Comedies of Goldoni. Second term. (3)

86. ITALIAN. Continuation of course 85. Reading of modern Italian authors, D'Annunzio, Verga, Serao, with selections from

Ariosto or Tasso. Lectures on the origin of the Italian language and literature. First term. (2)

87. Italian. Study of Dante's Vita Nuova. Assigned readings on Dante, Petrarch, and Boccaccio. Reports by class on subjects assigned. Lectures on the Italian literature of the Renaissance. First term. (1)

88. Italian. The Divina Commedia of Dante. Detailed study of Dante, his poem and his time. Reading of Fraticelli's or Scartazzini's Edition of La Divina Commedia, with critical explanations and lectures. Second term. (2)

Courses 60 and 61 in French, or equivalent, must precede course 85 in Italian.

## ENGLISH.

PROF. THAYER,

DR. WHITMAN, DR. THOMPSON, MR. LUCH.

90. Rhetoric. A composition course based on Genung's Working Principles of Rhetoric, involving recitations and weekly themes on assigned subjects. First term. (2)

91. American Literature. Lectures on the basis of Trent's History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's note-book. First term. (1)

92. History of the English Language. Lectures and classroom work, with the use of Lounsbury's History of the English Language as a text-book, supplemented by Emerson's and Champneys's. Second term. (2)

93. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Stopford Brooke's English Literature. First term. (2)

94. Literary Criticism. The subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from XIX Century Literature, earlier or later period. Second term. (2)

95. Essays, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

96. Essays, on subjects based on English Literature. Six essays a year meet this requirement.

97. English Literature of the 19th Century, the periods 1798-1830 and 1830-1900 being given in alternate years. A lecture course based on Saintsbury's XIXth Century Literature. First term. (1)

98. Oratory. A formal course based upon Baker's Principles of Argumentation and Baker's Specimens of Argumentation, with recitations and the writing of Briefs. First term. (1)

99. Anglo-Saxon. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term. (3)

100. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 99. Second term. (3)

101. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term. (3)

102. Poetics. A course based on Gummere's Handbook of Poetics, Alden's English Verse, Saintsbury's Loci Critici, and the use of Palgrave's Golden Treasury, The Oxford Book of English Verse, and Cook's The Art of Poetry, with practical exercises in verse-composition. Second term. (3)

103. To Seniors who wish to carry their linguistic work a little further, into the field of Teutonic philology, a course, alternative with 102, is offered, based upon Wright's Gothic Primer and Sweet's Icelandic Primer. Preparation required: 99 and 100. Second term. (3)

104. Optional courses on the Rise and Development of the English Novel and on the English Poets of the 19th Century (1830-1900) are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a

rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

### PUBLIC SPEAKING.

MR. EMERY.

108. Public Speaking. Practical instruction in Declamation, for all Freshmen. Second term. (1)

109. Public Speaking. Original Orations on topics of current interest, by all Sophomores. First term. (1)

## MATHEMATICS AND ASTRONOMY.

PROFESSOR THORNBURG,
ASSISTANT PROFESSOR MEAKER, ASSISTANT PROFESSOR LAMBERT,
MR. OGBURN, DR. MILLER, MR. STOCKER.

110. Solid Geometry, beginning with Book VII and completing the subject. First term. (1)

111. Trigonometry. Plane and Spherical Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 110. First term. (3)

112. Elementary Mechanics. Statics and dynamics with solutions of numerous illustrative and practical problems. First term. (4)

113. Trigonometry. Spherical Trigonometry, including mensuration and use of logarithmic tables. Second term. (1)

114. Advanced Algebra, beginning with theory of quadratic equations and completing the subject. Second term. (4)

115. Analytic Geometry. Graphic representation of loci on cross-section paper, plane and solid analytic geometry. Preparation required: 111 or 114. First term. (5)

116. Differential and Integral Calculus. Embracing applications to analytical geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 115. Second term. (5)

117. Analytical Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 116. First term. (2)

118. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 116 or 115 and 300. Second term. (3)

119. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 116, 118. First term. (3)

## FREEHAND DRAWING.

MR. GELHAAR.

125. Freehand Drawing, with special reference to architecture, construction and machine parts. First term. (2)

## CIVIL ENGINEERING.

PROFESSOR MERRIMAN,
MR. ROGERS, MR. RICE, MR. CHEW, MR. THAYER.

130. Architectural Drawing. Freehand sketching and perspective drawing of simple building details. The styles of architecture. First term. (1)

131. Descriptive Geometry. The use of instruments. Tracing and lettering. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 130. Second term. (3)

132. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 130, 131. First term. (4)

133. Land Surveying. The theory and computation of areas, dividing land, and determining heights and distances. Map drawing and topographic signs. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Map drawing from the students' field notes. Preparation required: 130, 131. Second term. (4); also in Summer term, four weeks.

134. Topographic Surveying. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 133. Summer term, four weeks, beginning June 16, 1904.

135. Railroad Surveying. Reconnaisance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 131, 133. Second term. (5)

136. Geodetic Surveying. Elements of the method of least squares and its application to the adjustment of triangulations. The figure of the earth. Field work in triangulation and in the determination of azimuth. Preparation required: 116, 118, 134. First term. (3)

137. Construction. Lectures on timber, stone, mortar, and concrete and on their use in structures. The construction of roads, streets, and pavements with the methods for their drainage and repair. Lectures on the history of engineering. Preparation required: 130, 131. First term. (2)

138. Construction. Lectures on foundations with piles, cribs, coffer dams, and caissons. Lectures on river and harbor improvements, on tunnels and canals, and on engineering work in progress of construction. Preparation required: 137. Second term. (2)

139. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 133, 138. First term. (2)

140. Cements. Lectures on the manufacture, properties, and testing of hydraulic cements and mortars. Each student makes all the standard tests in the cement laboratory. Preparation required: 360. First term. (1)

141. Dams and Arches. The theory and design of masonry walls, dams, and arches. Concrete steel beams and arches. Preparation required: 142. First term. (2) Not given in 1904-05.

142. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns,

and shafts, with the solution of many practical problems. Each student makes fourteen experiments in the testing laboratory, which is equipped with 20,000, 100,000 and 150,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion, and other apparatus for special work. Preparation required: 112, 116. First term. (4)

143. Materials. The materials of construction with reference to inspection and testing. Application of the theory of elasticity to the determination of true internal stresses. Stresses in guns. Preparation required: 142. First term. (2)

144. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 112, 131. First term. (2)

145. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to simple cases. Analysis of stresses in bridge trusses under dead loads. Retaining walls and masonry arches. Preparation required: 112, 131. First term. (5)

146. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live, and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 142. Second term. (3)

147. Bridge Design. The design of bridge floors and trusses. Sketches of details of bridges in the vicinity. Computations and working drawings are made from specifications for a railroad bridge of short span, and estimates of its weight are prepared. Preparation required: 146. First term. (6)

148. Bridges. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. Methods of analysis for statically indeterminate structures. Preparation required: 142, 146. Second term. (3)

149. Architectural Design. The design of steel trusses and three-hinged arches for trainsheds. The design of tall steel buildings. Building superintendence. Preparation required: 147. Second term. (3)

150. Heating and Ventilation. Methods of heating buildings with hot air, hot water, and steam. Methods of ventilation by flues and by forced blast. Details of boilers, piping, radia-

tors, and ventilating appurtenances. Preparation required: 112, 116. Second term, 1904. (2) Not given in 1905.

151. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 112, 116. Second term. (3)

152. Sanitary Engineering. Systems of water supply, including purification systems, reservoirs, pipe lines, and pumping plants. Preparation required: 139, 151. First term. (2)

153. Sanitary Engineering. Systems of sewerage and methods of sewage purification. House drainage. Preparation required: 152. Second term. (2)

154. Inspection Report. During the vacation between the Junior and Senior years each student in civil engineering is required to inspect some engineering work and prepare a report thereon. A brief description of the work or structure that the student desires to inspect must be presented to the Professor of Civil Engineering before July 15, and after approval, the report thereon must be submitted before September 15. These reports will contain such drawings and computations as each case may demand, and their length will usually be from twenty to thirty pages of letter paper.

155. Thesis for Degree of C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

## SUMMER SCHOOLS IN CIVIL ENGINEERING.

Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1904 this work begins at 8 A. M. on June 16 and ends on July 9.

The work in Land Surveying is described under No. 133, on page 46. Students in Mining Engineering and Geology are required to take this work at the close of the Freshman year. The fee for other persons is $20.

The work in Topographic Surveying is described under No. 134 on page 47. Students in Civil and Mining Engineering and Geology are required to take this subject at the close of the Sophomore year. The fee for other persons is $20.

Strength of Materials. Twenty-four exercises in the class-room and six in the testing laboratory will be given in 1904, beginning at 9 A. M. on August 22 and ending on September 17. As this work is a rapid review of the subject described under No. 142, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 15, 1904. The fee is $25.

Hydraulics. Twenty-two exercises in the class-room will be given in 1904, beginning at 11 A. M. on August 24 and ending on September 17. As this work is a rapid review of the subject described under No. 151, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineeing prior to June 15, 1904. The fee is $20.

Inspection Report. Inspection of engineering work and a report thereon is required of all students in civil engineering during the vacation following the junior year. This is described under No. 154 on page 49.

## MECHANICAL ENGINEERING.

PROFESSOR KLEIN,
ASSISTANT PROFESSOR HECK,
MR. STARKEY, DR. LOEWENSTEIN, MR. CHURCH.

170. Drawing and Elements of Machine Design. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Second term. (3)

171. Constructive Elements of Machinery. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are sepa-

rately taken into the shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 330. For further details see special circulars of the M.E. and E.E. departments. Summer term, four weeks, beginning June 16, 1904.

172. Elements of Machine Design. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. First term. (3)

173. Boilers. Description of various types, and of details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller. First term. (1)

174. Steam Engine. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Holmes's Steam Engine. Second term. (4)

175. Steam Engine. Shorter course. Second term. (3)

176. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is personally directed by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 16, 1904.

177. Mechanics of Machinery. Graphical statics of mechanisms. Determination of the efficiency of a machine and of the

forces acting in every one of its pieces and parts. All the problems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term. (2)

178. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term. (2)

179. Engineering Laboratory. Work of 178 continued. Indicator practice, on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term. (1)

180. Graphic Dynamics of a High Speed Engine. Complete force analysis, first by approximate practical methods and then by methods theoretically exact; action of steam forces, inertia resistances, etc. Preliminary design, consisting of a determination of the most important dimensions for an engine which is to work under given conditions. Second term. (3)

181. Mechanics of Machinery. Machinery of Transmission. Weisbach-Hermann series: Vol. III, Part I, Section I. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term. (3)

182. Summer School in Engineering Laboratory. Simple tests with steam—steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks, beginning June 16, 1904.

186. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and vapors. Application of the results and of graphical methods to technical problems. First term. (3)

187. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. This work is mainly expended on the construction of centrodes, on inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including many forms of inertia resistances and external forces. First term. (5)

188. Design of Special Machinery. Each student is required to design some example of metal working machinery, as a lathe, plane, drill, or milling machine, so as to gain experience in proportioning parts both for strength and stiffness. This design is followed by one for a still more special machine, say, for performing some unusual operation. First term. (5)

189. Design of Special Machinery. Shorter course. First term. (2)

190. Engineering Laboratory. Work of 179 and 182 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 182. First term. (1)

191. Engineering Laboratory. A shorter course, selected and condensed from 178 to 198 especially in steam engineering, for students in Marine, Metallurgical, Mining, and Electrical Engineering, and Electrometallurgy. First term. (1)

192. Engineering Laboratory. Work of 191 completed, along same lines. Second term. (1)

193. Mechanics of Machinery. Cranes, Excavators and Pile Drivers. Chapters VI to VIII, inclusive, of Weisbach-Herrmann's Mechanics of Hoisting Machinery. These recitations are supplemented by visits of inspection. The Locomotive. The descriptive portion of the work is illustrated by drawings from good current practice and includes visits to the L. V. R. R. Repair Shops at South Easton. The mechanics of the locomotive is taken up as fully as time will permit; the subjects touched on are: General proportions, detailed analysis of the forces and inertia resistances, valve gear action, performance of the running gear on curves, etc. Extensive use is made of diagrams showing the fluctuations of the various periodic forces throughout a revolution. First term. (2)

194. Design of Special Machinery. This work is mainly a continuation of course 188. To complete this course there is required an original design for a hoist, or hydraulic press, or an automatic machine used for manufacturing some such article as wire nails. Second term. (6) or (5)

195. Design of Special Machinery. An abridgment of course plete tests of the power plants of the vicinity. Second term. (1)

196. Engineering Laboratory. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term. (1)

197. Mechanics of Machinery. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrmann series. The class-room work is supplemented by suitably timed visits of inspection. Second term. (4)

198. Engineering Laboratory. Work of 190 carried forward, along same lines. Second term. (1)

200. Ship Calculations and Yacht Design. Laying down and fairing lines, calculation of displacement and metacentric sheets; curves of areas, block coefficients, etc.; stability, Barnes's method and method of cross curves, curves of stability, dynamical stability; surface of buoyancy, surface of waterlines; resistance and propulsion of ships. Text-books: Atwood's Theoretical Naval book: Peabody's Notes on Naval Architecture. Second term. (5)

201. Ship Drawing and Design. Dimensions of ship to suit given condition, and designing of liner, construction of steel ships, classification rules, specifications, strength of ships, theory of waves, rolling of ships, resistance and propulsion of ships. Text-book: Thomas Walton's Steel Ships, their Construction and Maintenance. First term. (5)

202. Marine Boilers. Description of the best modern types of water tube and fire tube boilers, their arrangements, details, proportions and design. Arrangement of machinery in ship. Text-book: Bertin & Robertson's Marine Boilers. First term. (1)

203. Ship Design. Powering of ships, and screw propellers, effect of movement and addition of weights, grounding or bilging; special types of vessels; strength of bulkheads; launching; steering and maneuvering; careening, docks and docking, sails and sailing, methods of calculating weights and vibrations. Text-book: Peabody's Notes on Naval Architecture. Second term. (5)

204. Marine Engines. Advanced study of the multiple cylinder engine, economy, determination of best expansion ratios, ar-

rangement of cylinders, discussion of the strength and proportion of moving parts, marine engine valve gears, equalization of work on several cranks, vibration and balancing of moving parts. Text-book: Bauer's Calculation and Construction of Marine Engines and Boilers. Reference books: Busley's The Marine Steam Engine, Seaton & Rounthwaite's Marine Engineer's Pocketbook, Sennett & Oram's The Marine Steam Engine. Second term. (2)

205. Summer School in Marine Engineering. Constructive elements of ships. Visits of inspection and of observation to the ships, shops, and yards of ship building establishments. Summer term, four weeks, beginning June 16, 1904.

210. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical or marine engineering. Drawings and diagrams are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 171 (connected with course 330), 176 182 and 205, also statement on page 72.

## IN MINERALOGY.

PROFESSOR FRAZIER, PROFESSOR RICHARDS, MR. LANDIS.

220. Crystallography. Elementary course in Geometric Crystallography, with practical exercises in the determination of crystalline forms in models and actual crystals. First term. (2)

221. Mineralogy. Elementary course in physical, chemical, and descriptive Mineralogy, with practical exercises in the determination of about two hundred of the more common mineral species. Text-book: E. S. Dana's Text-book of Mineralogy. Second term. (3)

222. Mineralogy. Shorter course. Second term. (2)

(A deposit of $5 is required from each student taking courses 220, 221 and 222, to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it will not exceed $2 for each student.)

223. Blowpipe Analysis. An elementary course in blowpipe analysis considered as a method of qualitative chemical analysis. Illustrated lectures followed by practical testing for thirty-five

bases and fifteen acids. Reference book: Plattner's Blowpipe Analysis, Latest English Edition, (1902). Second term. (1)

224. Blowpipe Analysis. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests for determining minerals. Text-book: Plattner's Löthrohrprobirkunde. Sixth German edition, revised by Dr. F. Kolbeck, or latest English translation. First term. (1)

225. Blowpipe Analysis. Laboratory course in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's Löthrohrprobirkunde. First term. (1)

(In each of the Blowpipe courses a deposit of $2 is required, of which, on an average, $1 is retained to cover cost of gas, chemicals, and specimens supplied.)

## IN METALLURGY.

PROFESSOR RICHARDS, MR. SULLIVAN, MR. LANDIS.

230. Drawing and Metallurgical Construction. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (4)

231. Metallurgical Construction and Drawing. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. Second term. (3) For students in Course in Mining Engineering. First term. (3)

232. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term. (2)

233. General Metallurgy and the Metallurgy of Iron. General Metallurgy: Metallurgical processes. Transmission of heat. Measurement of high temperatures. Furnaces. Fluxing. Fireproof materials. Principles of thermal chemistry. Combus-

tion. Properties of natural and artificial fuels. Manufacture of gaseous fuels. The Siemens Furnace. Charcoal burning. Coking. The electric furnace. Reference books: Schnabel's Allgemeine Hüttenkunde, Roberts-Austen's Introduction to the Study of Metallurgy.

Metallurgy of Iron: Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. Remelting in the foundry. Pig washing. Puddling. The Bessemer process. The open hearth process. Cementation. Manufacture of crucible steel. Direct processes. Methods of casting and forging. Reference books: Ledebur's Eisenhüttenkunde, Bauerman's Metallurgy of Iron. Second term. (5)

234. General Metallurgy and the Metallurgy of Iron. Shorter course. Reference book: Phillips-Bauerman's Elements of Metallurgy. Second term. (3)

235. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Mercury, and Aluminium. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. Reference book: Schnabel's Handbook of Metallurgy. First term. (4)

236. Metallurgical Laboratory. Calibration and use of pyrometers and calorimeters. Determination of melting and freezing points of metals and other metallurgical products. Study of cooling curves. Deposit, $10. Reference book: Howe's Metallurgical Laboratory Notes. Second term. (1)

237. Theory of Electrolysis. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions,

and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Lüpke's Elements of Electro-Chemistry. First term. (1)

238. Electrometallurgy. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electrometallurgie, Blount's Practical Electrochemistry. Second term. (1)

239. Electrometallurgical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Deposit, $10. First and second terms. (1)

240. Thesis for the Degree of Met. E. Every student in Metallurgical Engineering is required to present a thesis on some topic connected with this subject.

241. Thesis for the Degree of El. Met. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 171, 330, and 176, also statement on page 72.

## GEOLOGY.

ASSISTANT PROFESSOR IRVING.

250. Lithology. A brief description of those principles of structural and dynamic geology which bear upon the building up, deformation, and disintegration of rock masses, followed by a short laboratory course in the determination of the commoner rock species. Preparation required: 221. First term. (2)

251. Petrology. The optical properties of minerals and their study with the petrological microscope. Recitations and laboratory work. Preparation required: 221. Second term. (2)

252. Petrology. The determination of rocks; their chemical composition and classification; their origin. Recitations and laboratory work with microscope, combined with a study of hand specimens, and practice in the preparation and mounting of thin sections. Preparation required: 251. First term. (2)

(A deposit of $3.00 is required from each student taking 251 and 252, to cover wear and tear.)

253. Petrology. Advanced work in Petrology, consisting of detailed study of some few phases of the subject. Second term. (2)

254. Geology. A course in structural, dynamic and historical geology for those who desire to pursue the subject as a culture study, as well as for those who wish to obtain some knowledge of field geology without attaining the thoroughness necessary for the professional geologist or mining engineer. Recitations, lectures illustrated by suites of fossils and steropticon, field trips. This course includes a short review of those zoölogical and lithological principles necessary for a comprehension of the subject. Second term. (4)

255. Geology. Structural and dynamic geology. A course adapted to the needs of those who will use geology professionally. Lectures, recitations, assigned readings with trips in the field. Preparation required: 221. First term. (2)

256. Geology. A continuation of 255. Historical geology. Recitations and lectures illustrated with typical fossils. Preparation required: 272, 255. Second term. (2)

257. Geology. Invertebrate paleontology. Text-book and laboratory work in describing and identifying fossils. Preparation required: 256. First term. (4)

258. Economic Geology. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore deposition; the structure, geological horizon and geographic distribution of the principal metallic and non-metallic economic deposits of the United States and Canada. Recitations and lectures. Preparation required: 254, or 255 and 256. First term. (3)

259. Physiography. The classification of land forms; their stages of development; the factors determining them; their geographic distribution. Lectures, assigned reading, and field work. Preparation required: 254 or 255. Second term. (3)

260. Field Geology. Elementary field geology to accompany 252. Preparation required: 221, 272. First term. (3)

261. Field Geology. Field work to accompany the advanced petrology and historical geology. Second term. (3)

262. Field Geology. Geological maps; their use and the methods by which they are constructed. Forms of field notes. The methods adaptable to regions of sedimentary and eruptive rocks, of simple and complex structure, are discussed and com-

pared. Recitations and lectures, field work, problems in plotting geology on topographical maps. Preparation required: 254 or 255. Second term. (2)

263. Pennsylvania Geology. This course is advanced work consisting in the study of certain problems well illustrated in this State, combining the reading of the literature with laboratory and field work. Preparation required: All of the previous geology. Second term. (3) or (5)

264. Thesis for the Degree of B.S. (Geol.). Every student in this course who is a candidate for this degree is required to present a thesis on some topic connected with Geology.

For Summer Schools see courses 133 and 134, also statement on page 72.

## BIOLOGY.

DR. HALL.

270. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and references to text-books. Preparation advantageous: 272. Second term. (2)

271. Plant Biology (Elements of Forestry). Recitations and lectures on the morphology, physiology, adaptation to environment, and classification of plants, especially trees; embodying the hygiene of forest and shade trees and the characteristics of useful timber woods. Second term. (1)

272. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions: life, protoplasm, the cell, etc., (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories: variation, heredity, evolution, etc. First term. (3)

273. Zoölogy. Lectures on the embryology and comparative anatomy of vertebrates, with a more extended discussion of biological theories. In the laboratory, after a brief study of vertebrate embryology, examples of the chief classes of vertebrates will be dissected with a view to following the evolution of organs. Preparation required: 272. Second term. (3)

274. Histology. Lectures, reading, and laboratory work on the structure, growth, and differentiation of tissues. Preparation required: 273. First term. (2)

275. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. The quantitative microscopical examination of water. Study of bacteria: microscopical appearance, methods of staining, plate and tube cultures, etc. Preparation advantageous: 270 or 272. Second term. (2)

(A deposit of $5.00 is required of each student taking courses 270, 272, 273 and 275 to cover cost of material and breakage, which need not exceed $3.00.)

DR. ESTES.

279. Hygiene. Lectures and recitations on Physiology and Health. First term. (2)

## MINING ENGINEERING.

ASSISTANT PROFESSOR ECKFELDT, MR. SULLIVAN.

280. Prospecting. Modes of occurrence of minerals. Uses of Geology. Prospecting for placer, lode and bedded deposits. Magnetic prospecting. Preliminary boring. Sampling. Valuation of property. Location of claims. Patents to mining ground. Lectures and recitations. Preparation required: 254 or 255. Second term. (1)

281. Boring. Uses of bore holes. Methods: By rotation; by percussion with rods and ropes. Special methods: Shaft sinking by boring. Survey of bore holes. Lectures and recitations. Preparation required: 254 or 255. Second term. (1)

282. Mining. Location of plant; breaking ground; tools and machines. Explosives; laws; blasting. Shaft and slope sinking. Tunneling. Supporting excavations; timber, metal, masonry. Development of deposits. Systems of mining underground and at the surface. Lectures and recitations. Preparation required: 254 or 255. Second term. (3)

283. Transportation. Hoisting: Motors, ropes, and attachments. Receptacles. Safety appliances. Laws. Systems of hoisting. Haulage: Surface and underground. Motors, vehicles. Systems: Wire rope; aerial tramways. Loading and unloading; stocking and storage of minerals. Transportation of workmen. Signaling. Lectures and recitations. Preparation required: 112. First term. (1)

284. Drainage. Surface water. Prevention of access. Dams. Drainage by tunnels. Mechanical drainage; hoisting water;

pumping. Classes of pumps. Classes and positions of motors. Lectures and recitations. Preparation required: 112, 151. First term. (1)

285. Ventilation and Lighting. Atmosphere of mines. Pollution. Natural and artificial ventilation. Systems. Classes and efficiencies of ventilators. Testing air. Instruments. Laws. Lighting: Methods. Dangers. Laws. Safety-lamps. Lighting by electricity. Lectures and recitations. Preparation required: 300, 302, 305, 360. First term. (1)

286. Accidents. Classes. Causes. Means of prevention. Rescue. Hygiene of mines; rules and laws. First aid to injured. Lectures and recitations. Preparation required: All of preceding subjects. First term. (1)

287. Mine Constructions. The use of stone, brick, cement, concrete, metal and timber with special reference to mining plant. Foundations, piling, dams, reservoirs, retaining walls, mine buildings, trestles, tipples, ore-bins and docks. Lectures and recitations. Preparation required: All of preceding subjects. First term. (1)

288. Mine Administration. Management, organization, employment of labor, mine accounts, etc. Lectures and recitations. Preparation required: All of preceding subjects. Second term. (1)

289. Dressing. Theory of ore dressing. Physical principles involved. Machines used in wet, dry, and magnetic methods; order of arrangement. Processes. Location of works. Preparation of coal. Lectures and recitations. Preparation required: 221 or 222. First term. (3)

290. Mine Surveying and Mine Railroads. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes or tunnels. Calculation of notes; mapping. Location of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Preparation required: 133, 134. Summer term at the end of Junior year, four weeks, beginning June 16, 1904.

291. Mechanical Drawing. Use of instruments. Lettering. Sketches and working drawings of machine parts. Tracings and blue prints. Isometric and orthographic projections. Intersections and developments of cylinders, cones, spheres, etc. First term. (3) Second term. (1)

292. Mining Design. The design of parts of mining plant to meet given conditions, with detailed working drawings, accom-

panied by estimates of material and costs. Preparation required: 291, 142, 144, 177, and mining subjects. Second term. (4)

293. Thesis for Degree of E.M. Candidates are required to present a thesis on some topic connected with this subject. With the approval of the Professor of Metallurgy a subject may be taken from some topic in that course.

For Summer Schools see courses 133, 134, and 290, also statement on page 72.

## PHYSICS.

PROFESSOR FRANKLIN,

MR. MACNUTT, MR. CRAWFORD, DR. WHITEHORNE.

300. Elementary Physics. Mechanics and Heat. Lectures, recitations and problem work. Preparation required: 112. Second term. (2)

301. Elementary Physical Laboratory, accompanying 300. Fee $4.00. Second term. (1)

302. Elementary Physics. Electricity and Magnetism. Lectures, recitations, and problem work. Preparation required: 300, 301. First term. (3)

303. Elementary Physics. Mechanics, Heat, Electricity, and Magnetism. Lectures, recitations, and problem work. This study is offered to students in the School of General Literature. Preparation required: 112 or 114. First term. (3)

304. Elementary Physical Laboratory, accompanying 302 and 303. Fee $4.00. First term. (1)

305. Elementary Physics. Light and Sound. Lectures, recitations, and problem work. Preparation required: 302 or 303, and 304. Second term. (3)

306. Elementary Physical Laboratory accompanying 305. Fee $4.00. Second term. (1)

307. Advanced Theory of Electricity and Magnetism. Electrical units, electrical measurements, inductance, the magnetism of iron, and electromagnetic theory. Lectures, recitations, and problem work. Preparation required: 116 and 300 to 306, inclusive. First term. (2)

308. Electrical Laboratory, accompanying 307. Precise electrical measurements. Fee $5.00, deposit $5.00. First term. (1)

309. Electrical Laboratory. Continuation of 308. Precise electrical measurements. In connection with this study a num-

ber of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 333, 334, and 335. Fee $6.00, deposit $4.00. Second term. (1) For students in the Course in Physics: First term. (1)

310. Theory of Light. This study is based upon Preston's Theory of Light, supplemented by Drude's Lehrbuch der Optik and by the reading of monographs on optics. First term. (5)

311. Theory of Heat. This study is based upon Clausius's Theory of Heat, supplemented by the reading of monographs on Physical Chemistry. Second term. (4)

312. Physical Laboratory. This course in laboratory work, offered during the Senior year to students taking the Course in Physics, consists of refined measurements in any branch of Physics at the option of the student, and it leads to the thesis work of the following term. First term. (2)

313. Physical Seminary. The study of current literature in Physics. The membership of the Physical Seminary includes the corps of instructors of the department of Physics, together with Senior students in Physics. First and second terms. (2)

314. Electrical Laboratory, accompanying 237. Experimental studies in electrolysis. Measurements of resistances of electrolytes, applications of Faraday's laws of electrolysis, studies of electrolytic polarization, determinations of critical voltages of decomposition, tests of primary batteries and storage batteries, and tests of commercial types of electrolytic cells. Fee $4.00, deposit $6.00. First term. (1)

315. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recitations, and problem work. Preparation required: 307, 308, 331 (or 332). Second term. (2)

316. Theory of Alternating Currents. Continuation of 315. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 315, 333. First term. (2)

317. Theory of Alternating Currents. Continuation of 316. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 316. Second term. (3)

318. Thesis for the Degree of B.S. (in Physics). Each candidate for the degree of B.S. (in Physics) is required to present

a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory or experimental research.

## ELECTRICAL ENGINEERING.

PROFESSOR ESTY, MR. REGESTEIN.

330. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts. as follows: (a) Illustrated lectures, (b) Inspection and sketching of electrical machines and apparatus, and (c) Visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Fee $2.00. This work is accompanied by Constructive Elements of Machinery, No. 171. Summer term, four weeks, beginning June 16, 1904.

331. Dynamos and Motors. Elementary electrodynamics with applications to direct current machinery. Principles of construction, operation, and characteristics of dynamo electric machinery with special reference to direct current types. Illustrative problems. Preparation required: 300 to 306, inclusive, and simultaneous work in 307 and 308. First term. (3)

332. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the Senior year. Special attention is given to the operation, regulation, management, and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 300 to 306, inclusive, and simultaneous work in 307 and 308. First term. (2)

315. Theory of Alternating Currents. Given in the department of Physics. A general survey of the elementary theory of alternating currents. Lectures, recitations, and problem work. Preparation required: 307, 308, 331, (or 332). Second term. (2)

333. Electrical Engineering. Continuation of 332. General survey of the more important industrial applications of electricity.

Systems of generation, distribution, and transmission by direct and alternating currents; wiring; arc and incandescent lamps; feeder regulation. The latter part of the course is devoted to alternating current generators, motors, and transformers, being supplementary to the course in the Theory of Alternating Currents. Preparation required: 307, 331. Second term. (2)

334. Electrical Engineering. Continuation of 332. Similar in general scope to preceding. Particularly adapted to students who do not further specialize in the various technical applications above outlined. Preparation required: 307, 332. Second term. (2)

309. Electrical Laboratory. Given jointly by the departments of Physics and of Electrical Engineering. Continuation of 308. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 333, 334, and 335. Fee $6.00, deposit $4.00. Second term. (1)

316. Theory of Alternating Currents. Given in the department of Physics. Continuation of 315. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 315, 333. First term. (2)

335. Dynamo-Electric Machinery. Continuation of 331. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions; study of alternating current machinery is begun; illustrative problems. Preparation required: 315, 333. First term. (3)

336. Electrical Design. Accompanying 335. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 315, 333. First term. (2)

337. Electric Lighting and Power Stations. Systems of electric lighting; principles and economics of location of site; selection, arrangement, and subdivision of generating units; general design of buildings and interior arrangements. Methods and economics of distribution of electrical energy for light and power by direct and alternating currents; regulation and operation of supply circuits. Manufacture, care, and use of arc and incandescent lamps; insurance rules and regulations; commercial photometry; visits of inspection to neighboring plants. Preparation required: 315, 333. First term. (2)

338. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 315, 333. First term. (1)

339. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct and alternating current generators, and motors, rotary converters, transformers, potential regulators, and motor-generator sets. Special methods of testing large machines. Commercial tests as carried out by the large manufacturing companies. Preparation required: 307, 309, 315, 333. First term. (1)

340. Dynamo Laboratory. Direct current. Experimental studies and tests of direct current motors, dynamos, and appliances, for characteristics, regulation, efficiency, insulation, etc. Applications of 321. Preparation required: 315, 333. Fee $6, deposit $5. First term. (3)

340A. Shorter course for students in the course in Electrometallurgy. First term. (2)

317. Theory of Alternating Currents. Given in the department of Physics. Continuation of 316. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 316, 335, 336, 337, 340, 341. Second term. (3)

341. Electrical Design. Continuation of 336. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters and leading up to original designing; drafting. Preparation required: 316, 335, 336. Second term. (2)

342. Electrical Power Transmission and Traction. The long distance transmission of power by electricity for use in lighting, traction, mining, and manufacturing work. Design, construction, maintenance and protection of lines. Receiving systems. Electrical distribution, principles of construction, and testing of electric traction systems. Applications to surface and elevated electric roads and to mine haulage. Testing of light and power plants; visits of inspection to neighboring plants. Preparation required: 316, 335, 336. Second term. (2)

343. Electrical Engineering Seminary. Continuation of 338. Reports on thesis work are presented and discussed. Preparation required: 316, 335, 336, 337, 338. Second term. (1)

344. Dynamo Laboratory. Alternating current. Experimental studies and tests of alternating current generators and motors, rotary converters, transformers and auxiliary apparatus. Measurement of power in polyphase circuits. Preparation required: 316, 335, 340. Fee $6, deposit $5. Second term. (2)

345. Electrotechnology. This study includes a review of the principles of electricity and magnetism with special reference to their application to dynamo electric machinery, the elementary theory of dynamos and motors, and the study of the operation, regulation, management, and methods of testing dynamos and motors. Illustrative problems. Preparation required: 300 to 306 inclusive. First term. (2)

346. Electrotechnology, (Electric Railways). Continuation of 345. General survey of the more important industrial applications of electricity. This study is specially adapted to the needs of Civil and Mining engineers; particular attention is given to the generation, distribution, and utilization of electricity for lighting and power. Illustrative problems. Preparation required: 345. Second term. (2)

347. Thesis for the Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term. (3)

For Summer Schools see courses 171, 330, and 176, also statement on page 72.

## CHEMISTRY.

PROFESSOR CHANDLER,

DR. SCHOBER, DR. ULLMANN, MR. DIEFENDERFER, MR. BUCH, MR. OLPP.

360. General Introduction to Theoretical Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, lantern pictures, and specimens from the museum.

Note-books on the lectures required. Reference book: Remsen's Inorganic Chemistry, Advanced Course. First term. (2)

361. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. First term. (2)

362. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures. Text-book: Prescott and Johnson's Qualitative Chemical Analysis. Second term. (6)

363. Qualitative Analysis. Shorter courses. Second term. (3), (2), or (1)

364. Stoichiometry. Chemical problems, and reactions. Text-book: Thorpe and Tait's Chemical Calculations. Second term. (2)

365. Chemical Philosophy. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, solutions, electrolysis, thermo-chemistry, etc. Text-books: Tilden's Chemical Philosophy; Whitley's Chemical Calculations; Remsen's Inorganic Chemistry, Advanced Course. First term. (3)

366. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds. Text-book: Fresenius's Quantitative Analysis, edited by Allen and Johnson. First term. (6)

367. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term. (3)

368. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 366. First term. (1)

369. Quantitative Analysis. Continuation of course 367. Second term. (4)

370. Quantitative Analysis. Continuation of course 366. Analysis of minerals, ores, slags, alloys, etc. Text-books: Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term. (6)

371. Quantitative Analysis. Shorter course. Second term. (3) or (2)

372. Quantitative Analysis Conference. Discussions concerning laboratory work of course 370. Second term. (1)

373. Theoretical Chemistry. The elements and their compounds. Text-book: Remsen's Chemistry, Advanced Course. Second term. (3)

374. Toxicology. Lectures illustrated by experiments and by a large collection of specimens of poisons from the museum of chemistry, and supplemented by a short course of laboratory work on some of the common poisons. First term. (2)

375. Quantitative Analysis. Continuation of course 370. Ores and alloys; complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Fresenius's Quantitative Analysis edited by Allen and Johnson, Hempel's Gas Analysis. First term. (6)

376. Quantitative Analysis. Shorter course. Second term. (3) or (2)

377. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 375. First term. (1)

378. Quantitative Analysis. Continuation of course 369. Analysis of ores and metallurgical products, and gas analysis. First term. (3) or (2)

379. Organic Chemistry. Illustrated lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of converting compounds of one class into those of another. Text-books: Remsen's Introduction to the Study of the Carbon Compounds; Richter's Organic Chemistry, translated by Smith. First term. (5)

380. Organic Chemistry. Practical laboratory work. Determination of specific gravities, melting points, boiling points, vapor densities; also of chlorine, bromine, iodine, and sulphur of organic substances. Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds. Text-books: Gattermann's Practical Methods of Organic Chemistry, translated by Schober; Levy's Anleitung zur Darstellung Organischer Präparate. Second term. (6)

381. Organic Chemistry Conference. Discussions concerning the laboratory work of course 380. Second term. (1)

382. Industrial Chemistry. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; manufacture of coal gas; fermentation; bleaching. First term. (3)

383. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes practiced in the United States Mint. Text-book: Rickett's and Miller's Notes on Assaying. First term. (3)

384. Microscopy. Instruction in the use of the microscope. Text-book: Bausch's Manipulation of the Miscroscope. First term. (2)

385. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. Second term. (3)

386. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term. (3)

387. Industrial Analysis Conference. Discussion concerning the laboratory work of course 386. Second term. (1)

388. Agricultural Chemistry. The application of chemistry to problems in agriculture. Laboratory work. Second term. (1)

389. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer; and other subjects connected with this branch of the science. Second term. (1)

390. Physical Chemistry. Lectures and recitations. Text-book: Jones's Physical Chemistry. First term. (1)

391. Physical Chemistry. Laboratory work. Determination of molecular weights and physico-chemical measurements. First term. (1)

392. Electrochemistry. Lectures and recitations. Second term. (1)

393. Electrochemistry. Laboratory work. Preparation of chemicals by electrolysis. Electrochemical measurements. Second term. (1)

394. Technical German. Recitations based on German texts dealing with chemical subjects. Text-book for 1904: Levy's Anleitung zur Darstellung Organischer Präparate. Second term. (1)

395. Theses for the Degrees of A.C. and Ch.E. Preparation of a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the

library, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Five dollars each in courses 391 and 393; ten dollars each in courses 361, 384, 386, and 388; fifteen dollars in course 389; twenty dollars each in courses 378 and 382; twenty-five dollars each in courses 363, 367, 371, and 376; thirty dollars each in courses 362, 366, 369, 370, 375, and 383; thirty-five dollars in course 380.

Summer Schools. Courses in Qualitative and Quantitative Analysis, Assaying, and Microscopy begin June 16, 1904, and continue five weeks. They are open to all persons prepared to take them.

## PHYSICAL CULTURE.

DR. DAVIS.

410. Gymnasium. Graded calesthenic drills; heavy apparatus under group leaders. First term. (2)

411. Gymnasium. Calesthenics and heavy gymnastics in more advanced work. Class track practice. Preparation required: 410. Second term. (2)

All students of the University are admitted to these classes in Physical Culture.

## SUMMER SCHOOLS.

The summer schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, Metallurgical Engineering, Electrometallurgy, and Chemical Engineering, and in Mechanical Technology at the end of the Sophomore year in these courses, the summer school in Topographic Surveying in the courses of Civil Engineering, Mining Engineering, and Geology at the end of the Sophomore year, the summer school in Mine Surveying in the courses of Mining Engineering and Geology at the end of the Junior year, and also the summer school in Engineering Laboratory in the course of Chemical Engineering at the end of the Junior year are required studies and are therefore to be regarded as the summer terms of the courses. In the course of Mechanical Engineering the summer schools in Engineering Laboratory and in Marine Engineering, which are held at the

end of the Junior year, are required courses in their respective options. Likewise the instruction in Land Surveying at the end of the Freshman year is required of the students in the courses of Mining Engineering and Geology, but is optional for the students in the course in Civil Engineering. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine Surveying.

In addition to this required summer work, there are also summer schools in Mathematics, Strength of Materials, Hydraulics, Chemistry, Physics, German, and French designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned summer schools, with the exception of the summer schools in Chemistry, begin in August. A special circular giving details, fees required, etc., will be sent to those applying for it.

# SCHOOL OF GENERAL LITERATURE.

## PURPOSE AND METHOD.

The purpose of this department of the University is to provide systematic courses of study which shall meet the requirements of a liberal education, and lay the foundation for the study of the several professions and for the intelligent following of business and industrial pursuits. The University desires that these courses be not merely academic in character, but of practical worth, and sustain a direct relation to the sphere of life which each student has before him. That the culture-purpose which is the basis of them may not be ignored, a limited amount of work in subjects of a literary, philosophic, and scientific character, which are both accepted instruments of culture and necessary preliminaries of all higher study, is required of every student. The required work includes courses in the English, German, French, Latin, and Greek languages and literatures, in mathematics, physics, chemistry, economics, psychology, and philosophy. Beyond this the work is elective. Until the second term of the Sophomore year the studies are prescribed; from then on they become increasingly subject to the student's own choice.

In pursuance of the policy of making these courses practical and directly preparatory to each student's life-work, large freedom is allowed in the choice of electives. Any study which is taught in the University may be taken, subject to the qualification and purpose of the student. Students are counseled to select their work systematically with reference to some definite end. In this they receive the assistance and coöperation of the Faculty, under the oversight of one of whose members each student arranges his course. Endeavor is made to treat students individually rather than in groups, and to suit the work of each to his needs and qualifications. Instruction is given by lectures, by recitations, by the assignment of readings and of topics for special study and dissertations, and when the subject admits of it, by practical work in field or laboratory. Field-work or laboratory work accompanies courses in surveying, geology, physics, chemistry, astronomy, biology, psychology, and allied subjects.

### ADMISSION, CLASSIFICATION, DEGREE.

The requirements for admission are stated in detail on pages 20 to 22. On the basis of these the studies of the School of General Literature are classified, for the sake of convenience, into the Classical and Latin-Scientific courses. Greek is required in the Classical course; its place is taken in the Latin-Scientific course by modern languages, mathematics, and science. Except for such separation as grows necessarily out of this difference in the qualifications for admission the two courses are parallel.

The course of study extends over four years. Students, however, who can do so, are permitted to pass off required work in advance and to fill up the time thus left free with other advanced studies, with a view to completing the requirements for graduation in a shorter time.

The degree of Bachelor of Arts is bestowed upon all graduates of the School of General Literature.

### PREPARATION FOR LAW, MEDICINE, TEACHING, ETC.

Young men who have in view the profession of law, medicine, theology, teaching, or journalism, will find in the courses of study which this department of the University offers that general and special preliminary training which is more and more becoming essential. For the better preparation of such men for entrance upon their professional studies the University is constantly enlarging its curriculum as need determines. Laboratory work has been added to the courses in psychology, and the completion of Williams Hall has made possible better facilities for the teaching of biology and zoölogy, and the addition of a course in bacteriology. The opportunities for preliminary medical studies which the University thus affords are unsurpassed.

### COMBINATION OF LITERARY AND TECHNICAL STUDIES.

The desirability of a liberal training for an engineer has led the University to offer courses in which, by combining the studies of the several technical departments with the work of the School of General Literature, a student may gain both a literary and a professional education, with the corresponding degrees, in six years. These courses possess decided advantages over the usual engineering curriculum of four years, the studies of which are necessarily almost wholly technical; and the value of the wider

training for which they provide far outweighs the extra expenditure of time. The outline in full of a combined course leading to the degrees of B.A. and C.E. is printed on pages 79 to 81.

### TABULAR EXHIBITION OF STUDIES.

The following tables of studies exhibit the required and the ordinary elective studies of the School of General Literature. Those peculiarly technical studies which enter into the combined courses are not here printed in the lists of electives. Further information regarding this department of the University, the systematic arrangement of work preparatory to professional study, to teaching, etc., can be found in the circular of the School of General Literature, copies of which may be had by addressing the Registrar of the University.

## THE CLASSICAL COURSE.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Sol.Geom. and Trig., (4) | 110,111 | Algebra and Trig., (5) | 113,114 |
| Greek, (4) | 40 | Greek, (4) | 41 |
| Latin, (4) | 30 | Latin, (4) | 31 |
| German, (2) | 70 | German, (2) | 71 |
| English, (3) | 90, 91, 95 | English, (2) | 92, 95 |
| Hygiene, (2) | 279 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Greek, (3) | 42 | Greek, (3) | 43 |
| Latin, (3) | 32 | Latin, (3) | 33 |
| German, (3) | 72 | German, (3) | 73 |
| French, (2) | 60 | French, (2) | 61 |
| English, (2) | 93, 96 | English, (2) | 94, 96 |
| Physics, (3) | 303 | (*Elective, four hours*) | |
| Physical Laboratory, (1) | 304 | Greek, (2) | 44 |
| Public Speaking, (1) | 109 | Latin, (2) | 34 |
| | | History, (2) | 23 |
| | | Descriptive Geometry, (3) | 131 |
| | | *Land Surveying, (4) | 133 |
| | | Physics, (3) | 305 |
| | | Physical Laboratory, (1) | 306 |
| | | Botany, (2) | 270 |
| | | Forestry, (1) | 271 |

*May be taken in the Summer Term after the Sophomore year.

## JUNIOR YEAR.

FIRST TERM (*Required*).

| | |
|---|---|
| Psychology, (2) | 3 |
| Economics, (2) | 10 |
| English, (1) | 97 |
| European History, (1) | 20 |
| Chemistry, (2) | 360 |
| Chemical Laboratory, (2) | 361 |
| (*Elective, seven hours*) | |
| Greek, (3) | 45 |
| Latin, (3) | 35 |
| French, (3) | 62 |
| German, (2) | 74 |
| English, (3) | 99 |
| History, (2) | 24 |
| Mechanics, (4) | 112 |
| Analytic Geometry, (5) | 115 |
| Elec. and Magnetism, (2) | 307 |
| Electrical Laboratory, (1) | 308 |
| Crystallography, (2) | 220 |
| Biology, (3) | 272 |
| Pedagogy, (1) | 7 |

SECOND TERM (*Required*).

| | |
|---|---|
| Psychology, (2) | 4 |
| Economics, (2) | 11 |
| European History, (1) | 20 |
| (*Elective, twelve hours*) | |
| Greek, (3) | 46 |
| Latin, (3) | 36 |
| French, (3) | 63 |
| German, (2) | 75 |
| English, (3) | 100 |
| Italian, (3) | 85 |
| History, (2) | 25 |
| Calculus, (5) | 116 |
| Astronomy, (3) | 118 |
| Alternating Currents,(2) | 315 |
| Electrical Laboratory, (1) | 309 |
| Mineralogy, (3) | 221 |
| Blowpipe Analysis, (1) | 223 |
| Qualitative Analysis, (3) | 363 |
| Stoichiometry, (2) | 364 |
| Zoölogy, (3) | 273 |
| Pedagogy, (1) | 7 |

## SENIOR YEAR.

FIRST TERM (*Required*).

| | |
|---|---|
| History of Philosophy, (2) | 1 |
| (*Elective, fifteen hours*) | |
| Greek, (3) | 47 |
| Latin, (3) | 37 |
| German, (2) | 76 |
| French, (2) | 64 |
| Spanish, (2) | 80 |
| Italian, (3) | 86, 87 |
| English, (3) | 101 |
| Economics, (2) | 12 |
| Politics, (2) | 14 |
| Analytic Mechanics, (2) | 117 |
| Practical Astronomy, (3) | 119 |
| Theory of Light, (5) | 310 |
| Alternating Currents, (2) | 316 |
| Quantitative Anal., (3) | 367 |
| Lithology, (2) | 250 |
| Histology, (2) | 274 |
| Psychology,(2),(3), *or* (4) | 5, 6 |
| History of Education, (1) | 8 |

SECOND TERM (*Required*).

| | |
|---|---|
| History of Philosophy, (2) | 2 |
| Thesis, (3) | |
| (*Elective, twelve hours*) | |
| Greek, (3) | 48 *or* 49 |
| Latin, (3) | 38 |
| German, (2) | 77 |
| French, (2) | 65 |
| Spanish, (2) | 81 |
| Italian, (2) | 88 |
| English, (3) | 102 *or* 103 |
| Economics, (2) | 13 |
| Politics, (2) | 15 |
| Astronomy, (3) | 118 |
| Theory of Heat, (4) | 311 |
| Alternating Currents, (2) | 317 |
| Quantitative Anal., (4) | 369 |
| Geology, (4) | 254 |
| Sanitary Biology, (2) | 275 |
| Psychology,(2),(3), *or* (4) | 5, 6 |
| History of Education, (1) | 8 |

The figures in parentheses indicate the number of exercises per week.

## THE LATIN-SCIENTIFIC COURSE.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Latin, (4) | 30 | Latin, (4) | 31 |
| German, (3) | 72 | German, (3) | 73 |
| *or* French, (3) | 62 | *or* French, (3) | 63 |
| Freehand Drawing, (2) | 125 | English, (2) | 92, 95 |
| *or* Arch. Drawing, (2) | 130 | Descriptive Geometry, (3) | 131 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Hygiene, (2) | 279 | Gymnasium, (2) | 411 |
| Gymnasium, (2) | 410 | | |

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Latin, (3) | 32 | Latin, (3) | 33 |
| German, (2) | 74 | German, (2) | 75 |
| French, (2) | 60 *or* 64 | French, (2) | 61 *or* 65 |
| English, (2) | 93, 96 | English, (2) | 94, 96 |
| Physics, (3) | 303 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Chemistry, (2) | 360 | (*Elective, four hours*) | |
| Chemical Laboratory, (2) | 361 | Latin, (2) | 34 |
| Public Speaking, (1) | 109 | History, (2) | 23 |
| | | *Land Surveying, (4) | 133 |
| | | Qualitative Anal., (3) | 363 |
| | | Stoichiometry, (2) | 364 |
| | | Botany, (2) | 270 |
| | | Forestry, (1) | 271 |

### JUNIOR YEAR.

| FIRST TERM (*Required*). | | SECOND TERM (*Required*). | |
|---|---|---|---|
| Psychology, (2) | 3 | Psychology, (2) | 4 |
| Economics, (2) | 10 | Economics, (2) | 11 |
| French, (3) | 62 | French, (3) | 63 |
| *or* German, (3) | 72 | *or* German, (3) | 73 |
| English, (1) | 97 | European History, (1) | 20 |
| European History, (1) | 20 | (*Elective, nine hours*) | |
| (*Elective, eight hours*) | | Latin, (3) | 36 |
| Latin, (3) | 35 | German, (2) | 77 |
| German, (2) | 76 | *or* French, (2) | 67 |
| *or* French, (2) | 66 | English, (3) | 100 |
| English, (3) | 99 | Italian, (3) | 85 |
| History, (2) | 24 | History, (2) | 25 |
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Elec. and Magnetism, (2) | 307 | Mineralogy, (3) | 221 |
| Electrical Laboratory, (1) | 308 | Blowpipe Analysis, (1) | 223 |
| Crystallography, (2) | 220 | Quantitative Anal., (4) | 369 |
| Quantitative Anal., (3) | 367 | Alternating Currents, (2) | 315 |
| Biology, (3) | 272 | Electrical Laboratory, (1) | 309 |
| Pedagogy, (1) | 7 | Astronomy, (3) | 118 |
| | | Zoölogy, (3) | 273 |
| | | Pedagogy, (1) | 7 |

*May be taken in the Summer Term after the Sophomore year.

SENIOR YEAR.

| FIRST TERM (*Required*). | | SECOND TERM (*Required*). | |
|---|---|---|---|
| History of Philosophy, (2) | 1 | History of Philosophy, (2) | 2 |
| (*Elective, fifteen hours*) | | Thesis, (3) | |
| Latin, (3) | 37 | (*Elective, twelve hours*) | |
| French, (2) | 68 | Latin, (3) | 38 |
| German, (2) | 78 | French, (2) | 69 |
| Spanish, (2) | 80 | German, (2) | 79 |
| Italian, (3) | 86, 87 | Spanish, (2) | 81 |
| English, (3) | 101 | Italian, (2) | 88 |
| Economics, (2) | 12 | English, (3) | 102 *or* 103 |
| Politics, (2) | 14 | Economics, (2) | 13 |
| Analytic Mechanics, (2) | 117 | Politics, (2) | 15 |
| Practical Astronomy, (3) | 119 | Astronomy, (1) | 118 |
| Alternating Currents, (2) | 316 | Geology, (4) | 254 |
| Theory of Light, (5) | 310 | Alternating Currents, (2) | 317 |
| Histology, (2) | 274 | Theory of Heat, (4) | 311 |
| Psychology, (2), (3), *or* (4) | 5, 6 | Sanitary Biology, (2) | 275 |
| History of Education, (1) | 8 | Psychology, (2), (3), *or* (4) | 5, 6 |
| | | History of Education, (1) | 8 |

The figures in parentheses indicate the number of exercises per week.

## COMBINED ACADEMIC AND ENGINEERING COURSES.

The University considers it desirable that young men who expect to follow an engineering profession receive a broader education than is possible in an engineering course of four years' duration, which must of necessity be occupied almost exclusively by subjects of a technical and professional character. A good many subjects which are essential to an engineering curriculum are proper also to academic courses. But an academic student who subsequently proceeds to engineering study often finds that his training in these common branches has been inadequate to the successful application of them to engineering work. Time can be saved and more efficient preparation given when they are under one common guidance. The University is able, by systematically combining the studies of its several engineering schools with the studies peculiar to the School of General Literature, to offer courses of six years' duration which lead to the degree of Bachelor of Arts and an engineering degree, and in which neither the purpose nor the efficiency of either course is sacrificed. Students in these courses receive the Bachelor's degree at the end of four years, the engineering degree upon the completion of the engineering studies.

Following is an outline in full of such a course leading to the degrees of Bachelor of Arts and Civil Engineer. For the sake of brevity, the course is printed only for a Latin-Scientific student, who has presented German for admission. Classical students, or Latin-Scientific students presenting French for admission, may select a similar course. Combined courses leading to other engineering degrees are also provided.

## FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113,114 |
| Latin, (4) | 30 | Latin, (4) | 31 |
| German, (3) | 72 | German, (3) | 73 |
| Freehand Drawing, (2) | 125 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Descriptive Geometry, (3) | 131 |
| Hygiene, (2) | 279 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Latin, (3) | 32 | Latin, (3) | 33 |
| German, (2) | 74 | German, (2) | 75 |
| French, (2) | 60 | French, (2) | 61 |
| English, (2) | 93, 96 | English, (2) | 94, 96 |
| Physics, (3) | 303 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Chemistry, (2) | 360 | Land Surveying, (4) | 133 |
| Chem. Laboratory, (2) | 361 | | |
| Public Speaking, (1) | 109 | | |

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Psychology, (2) | 1 | Psychology, (2) | 2 |
| Economics, (2) | 10 | Economics, (2) | 11 |
| English, (1) | 97 | European History, (1) | 20 |
| French, (3) | 62 | Qualitative Anal., (3) | 363 |
| European History, (1) | 20 | Calculus, (5) | 116 |
| Analytic Geometry, (5) | 115 | *(At least four hours from following.)* | |
| *(At least three hours from following.)* | | Latin, (3) | 36 |
| Latin, (3) | 35 | English, (3) | 100 |
| English, (3) | 99 | German, (2) | 77 |
| German, (2) | 76 | French, (3) | 63 |
| Biology, (3) | 272 | Italian, (3) | 85 |
| History, (2) | 24 | Zoölogy, (3) | 273 |
| Pedagogy, (1) | 7 | History, (2) | 25 |
| | | Pedagogy, (1) | 7 |

## SENIOR YEAR.

FIRST TERM.

History of Philosophy, (2) 1
Construction, (2) 137
Stereotomy, (4) 132
*(At least nine hours from following.)*
Latin, (3) 37
German, (2) 78
French, (2) 63
Spanish, (2) 80
Italian, (3) 86, 87
English, (3) 101
Economics, (2) 12
Politics, (2) 14
History of Education, (1) 8
Lithology, (2) 250
Quantitative Analysis, (3) 367
Blowpipe Analysis, (1) 224

SECOND TERM.

History of Philosophy, (2) 2
Construction, (2) 138
Botany, (2) 270
Thesis, (3)
*(At least eight hours from following.)*
Latin, (3) 38
German, (2) 79
French, (2) 64
Spanish, (2) 81
Italian, (3) 88
English, (3) 102
Economics, (2) 13
Politics, (2) 15
History of Education, (1) 8
Geology, (4) 254
Quantitative Analysis, (4) 369
Sanitary Biology, (2) 275

SUMMER TERM.

Topographic Surveying, 134.

## FIFTH YEAR.

FIRST TERM.

Analytic Mechanics, (2) 117
Strength of Materials, (4) 142
Railroads, (2) 139
Cement Testing, (1) 140
Graphic Statics, (5) 145
Crystallography, (2) 220

SECOND TERM.

Railroad Surveying, (5) 135
Hydraulics, (3) 151
Roofs and Bridges, (3) 146
Astronomy, (3) 118
Mineralogy, (2) 222

SUMMER TERM.

Inspection Report, 154.

## SIXTH YEAR.

FIRST TERM.

Bridge Design, (6) 147
Sanitary Engineering, (2) 152
Mech. of Machinery, (2) 177
Electrotechnology, (2) 345
Materials, (2) 143
*or* Dams and Arches, (2) 141
*or* Lithology, (2) 250
Geodetic Surveying, (3) 136
*or* Practical Astron., (3) 119

SECOND TERM.

Bridges, (3) 148
Sanitary Engineering, (2) 153
Geology, (4) 254
*or* Steam Engine, (4) 174
Electric Railways, (2) 346
*or* Sanitary Biology, (2) 275
Architectural Design, (3) 149
*or* Metallurgy, (3) 234
Thesis, (3) 155

**The figures in parentheses indicate the number of exercises per week.**

## THE COURSE IN CIVIL ENGINEERING.

The requirements for admission to this course may be found on pages 23 and 24. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The program of studies of this course, given on page 85, shows the subjects required to be completed by candidates for the degree of Civil Engineer. The numbers following the subjects refer to the detailed descriptions on pages 36 to 72. The figures in parentheses indicate the number of exercises per week. Candidates for admission who are prepared to take an examination in the Chemistry of the Freshman year will be given an opportunity to do so, and those passing that examination will take Stoichiometry during the first term.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term civil engineering. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, freehand sketching in the first term and instrumental work in the second. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed and the technical work of civil engineering is begun by practical problems in Drawing and by lectures on Construction. The theory of Land Surveying is begun and is accompanied by field work and map drawing. Those who desire to take this subject in the vacation at the end of the Freshman year will be allowed to do so under the regulations stated on page 49.

The work in Topographic Surveying is done in the four weeks following the end of the Sophomore year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying tools enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction are grouped the topics of masonry, foundations, roads and pavements, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is mainly by lectures, with references to standard books and engineering journals. Visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is begun in the first term of the Junior year and later the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, designs and working drawings are prepared by each student for both highway and railroad bridges. These drawings are made, dimensioned, and checked in the same manner as in the drafting room of a bridge company, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures also receives detailed attention. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of collecting, purifying, and distributing water are explained and

compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in Hydraulic and Sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Mechanics of Machinery treats of cranes, elevators and locomotives, and that of Electric Railroads of the equipment and operation of trolley roads. The subjects of Crystallography and Mineralogy give excellent training in the observation of natural phenomena, and prepare the student for work in geology and mining.

During the Senior year there are several elective subjects offered. Those intending to work in the line of architectural engineering will naturally elect Architectural Design, while those wishing to work in the direction of mining and metallurgy will select Lithology, Geology, and the Metallurgy of Iron. Other elective subjects are Steam Engine, Electric Railways, Bacteriology, and an advanced course in Materials of Construction, with special reference to inspection and testing. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs or laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who prepare theses on investigations of the properties of materials.

The student who completes this course will receive the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 27.

## THE COURSE IN CIVIL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 560 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Descriptive Geometry, (3) | 131 |
| *or* French, (3) | 62 | Forestry, (1) | 271 |
| Freehand Drawing, (2) | 125 | German *or* French, (3) | 73 *or* 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Land Surveying (optional), 133.

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Construction, (2) | 137 | Construction, (2) | 138 |
| Stereotomy, (4) | 132 | Land Surveying, (4) | 133 |
| English, (2) | 93, 96 | English, (2) | 94, 96 |
| Public Speaking, (1) | 109 | | |

SUMMER TERM.

Topographic Surveying, 134.

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 117 | Railroad Surveying, (5) | 135 |
| Strength of Materials, (4) | 142 | Hydraulics, (3) | 151 |
| Railroads, (2) | 139 | Roofs and Bridges, (3) | 146 |
| Cement Testing, (1) | 140 | Astronomy, (3) | 118 |
| Graphic Statics, (5) | 145 | Economics, (1) | 11 |
| Economics, (1) | 10 | Mineralogy, (2) | 222 |
| Crystallography, (2) | 220 | | |

SUMMER TERM.

Report on Inspection of Engineering Work, 154.

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Bridge Design, (6) | 147 | Bridges, (3) | 148 |
| Sanitary Engineering, (2) | 152 | Sanitary Engineering, (2) | 153 |
| Mech. of Machinery, (2) | 177 | Geology, (4) | 254 |
| Electrotechnology, (2) | 345 | *or* Steam Engine, (4) | 174 |
| Materials, (2) | 143 | Electric Railways, (2) | 346 |
| *or* Dams and Arches, (2) | 141 | *or* Sanitary Biology, (2) | 275 |
| *or* Lithology, (2) | 250 | Architectural Design, (3) | 149 |
| Geodetic Surveying, (3) | 136 | *or* Metallurgy, (3) | 234 |
| *or* Prac. Astronomy, (3) | 119 | Thesis, (3) | 155 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurement of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a summer term, lasting four weeks, which is held at the close of the second term of the Freshman year.

In this same summer term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of Physics and to the special course in Electrical Engineering which is pursued later on.

A second summer term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing the student with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery.

During the course there are frequent visits of inspection to the Bethlehem Steel Company, to the Lehigh Valley R. R. shops at Easton, and to other engineering works both in and out of town, with special reference to such subjects as prime movers, machinery for lifting, handling, and transporting, and machinery for changing the form and size of materials.

The instruction in Machine Design begins in the second term of the Freshman year and is continued throughout the course. At first tracings and blue-prints of good examples of drawings of machinery are made. A thorough drill in projection drawing follows; in this work freehand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such drawings, and general views of lathes, planers, drills, and shapers are made from the drawings of the details. This is followed by difficult projections

and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the partial design of a high-speed steam engine, the leading dimensions being determined by the students. In the next year the Seniors undertake the calculations, estimates, and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. In the case of these machines and of the engine the general plan of arrangement will be given to the students in the form of rough sketches, photographs or woodcuts. In the last term the students are expected to make original designs for simple machinery, the object of which has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency. Instruction is also given in locating and remedying the common faults of dynamos and motors.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering; the simpler tests and experiments, along various lines, are taken up next; and there is a gradual progress toward complex operations as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam-traps and separators, and of injectors, small pumps, and

the steam turbine; extensive practice with the indicator, engine tests of various sorts, and boiler testing.

Work with compressed air, tests of hot-air engines, of centrifugal pumps, and of various incidental appliances and apparatus, are to be given due place in the course. Gas engineering, in particular, will be well provided for when the new laboratory in Williams Hall is fully equipped. This laboratory will also be especially devoted to dynamometer work and power transmitting machinery, with experiments in friction and lubrication, and determination of the efficiency of machines.

The purpose of this course, kept in view in the equipment and arrangment of the laboratory, is to provide a system of well selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student, and give a broad training in the idea, method, and detail of this sort of work. For this course there is available the newly-constructed Steam Engineering Laboratory and the additional space reserved in Williams Hall for the experimental apparatus, machinery, and motors presented by Mr. Warren A Wilbur to the department of Mechanical Engineering.

All the students in this course are required to study both German and French.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

## THE COURSE IN MECHANICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Draw'g and Mach. Des., (3) | 170 |
| *or* French, (3) | 62 | German, (3) | 73 |
| Freehand Drawing, (2) | 125 | *or* French, (3) | 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Machine Design, (3) | 172 | Steam Engine, (4) | 174 |
| Boilers, (1) | 173 | French, (2) | 61 |
| French, (2) | 60 | *or* German, (2) | 71 |
| *or* German, (2) | 70 | English, (2) | 94, 96 |
| English, (2) | 93, 96 | | |
| Public Speaking, (1) | 109 | | |

SUMMER TERM.

Mechanical Technology, 176.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 117 | Graphic Dynamics, (3) | 180 |
| Mech. of Machinery, (2) | 177 | Mech. of Machinery, (3) | 181 |
| Dynamos and Motors, (2) | 332 | Hydraulics, (3) | 151 |
| Elec. and Magnetism, (2) | 307 | Electrical Laboratory, (1) | 309 |
| Electrical Laboratory, (1) | 308 | Engineer'g Laboratory, (1) | 179 |
| Engineer'g Laboratory, (2) | 178 | Elec. Engineering, (2) | 334 |
| Strength of Materials, (4) | 142 | Alternating Currents, (2) | 315 |
| Economics, (1) | 10 | Economics, (1) | 11 |
| French, (2) | 62 | French, (2) | 63 |
| *or* German, (2) | 72 | *or* German, (2) | 73 |

SUMMER TERM.

Engineering Laboratory, 182.

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Thermodynamics, (3) | 186 | Machine Design, (6) | 194 |
| Kinematics of Mach., (4) | 187 | Engineer'g Laboratory, (1) | 198 |
| Machine Design, (5) | 188 | Metallurgy, (3) | 234 |
| Engineer'g Laboratory, (1) | 190 | Mech. of Machinery, (4) | 197 |
| Graphic Statics, (2) | 144 | Thesis, (3) | 210 |
| Mech. of Machinery, (2) | 193 | | |

A special option in Electrical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN MARINE ENGINEERING.

The foundation for this course is that of Mechanical Engineering, which is closely followed by the Marine Engineering after the first two and a half years. During the second term of the Junior year and the whole of the Senior year the Marine and Naval Architecture subjects replace some of those given in Mechanical Engineering.

The course, though called Marine Engineering, includes much of Naval Architecture. In reality it embraces a large part of the theoretical and practical work of the design and construction of a modern steel ship, as well as the study and design of its machinery. The course throughout consists of class-room work carried on (as nearly as possible) parallel to, and simultaneously with, the drafting-room work.

At the end of the Junior year there is a summer term of four weeks devoted to acquiring the nomenclature of the constructive elements of a ship, to the study of practical ship-building in the shops and yards of ship-building establishments, and to observing arrangement of plants, sequence of work and the methods of laying out, handling, and erecting used with hulls in process of construction in the various yards. Attention is also paid to engine arrangement, construction and erection, and to the arrangement of auxiliary machinery, piping and boilers on board ship.

At the beginning of the Senior year the student selects a design and from then on all practice in arranging, calculating and designing is made on that particular design as far as possible. Further retails of the course are given in the list of studies on pages 36 to 72.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

## THE COURSE IN MARINE ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Draw'g and Mach. Des., (3) | 170 |
| *or* French, (3) | 62 | German, (3) | 73 |
| Freehand Drawing, (2) | 125 | *or* French (3) | 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Machine Design, (3) | 172 | Steam Engine, (4) | 174 |
| Boilers, (1) | 173 | French, (2) | 61 |
| French, (2) | 60 | *or* German, (2) | 71 |
| *or* German, (2) | 70 | English, (2) | 94, 96 |
| English, (2) | 93, 96 | | |
| Public Speaking, (1) | 109 | | |

SUMMER TERM.

Mechanical Technology, 176.

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 117 | Mech. of Machinery, (3) | 183 |
| Mech. of Machinery, (2) | 177 | Hydraulics, (3) | 151 |
| Dynamos and Motors, (2) | 332 | Electrical Engineering, (2) | 334 |
| Elec. and Magnetism, (2) | 307 | Electrical Laboratory, (1) | 309 |
| Electrical Laboratory, (1) | 308 | Engineer'g Laboratory, (1) | 179 |
| Engineer'g Laboratory, (2) | 178 | Engineer'g Laboratory, (1) | 192 |
| Engineer'g Laboratory, (1) | 191 | Ship Calculations, (5) | 200 |
| Strength of Materials, (4) | 142 | French, (2) | 63 |
| French, (2) | 62 | *or* German, (2) | 73 |
| *or* German, (2) | 72 | | |

SUMMER TERM.

Constructive Elements of Ships, 205.

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Thermodynamics, (3) | 186 | Machine Design, (5) | 192 |
| Kinematics of Mach., (4) | 187 | Metallurgy, (3) | 234 |
| Machine Design, (5) | 188 | Marine Engines, (2) | 204 |
| Ship Draw. and Des., (5) | 201 | Ship Design, (5) | 203 |
| Marine Boilers, (1) | 202 | Thesis, (3) | 210 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN METALLURGICAL ENGINEERING.

This course is designed to prepare the student for practice in the field of Metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, including work in the testing laboratory applied to stresses in metallic structures, Mechanical Technology, Steam Boilers, the Steam Engine, the Mecnanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., the Measurement of Power, Hydraulics, including hydraulic motors, and Electrotechnology, including the theory of electric motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses in Mineralogy and Blowpipe Analysis involve practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. The mineralogical laboratory affords facilities for advanced courses in geometric and physical crystallography which are not included in the ordinary curriculum. An elective course in Quantitative Blowpipe Analysis is open to a limited number of students.

A course in Lithology gives practice in the identification of rocks and is followed by courses in Historic, Dynamic and Economic Geology.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparation of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes of an assigned portion of the plant. From these working drawings are made and memoirs written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout the year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them.

The vicinity of the works of the Bethlehem Steel Company and of the New Jersey Zinc Company, and the kindness of their officers, give opportunities for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and of zinc. Occasional visits of inspection are made to more distant works.

Graduates in this course receive the degree of Metallurgical Engineer (Met.E.).

## THE COURSE IN METALLURGICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Qualitative Analysis, (3) | 363 |
| *or* French, (3) | 62 | Stoichiometry, (2) | 364 |
| Freehand Drawing, (2) | 125 | German, (3) | 73 |
| Hygiene, (2) | 279 | *or* French, (3) | 63 |
| English, (3) | 90, 91, 95 | English, (2) | 92, 95 |
| Gymnasium, (2) | 410 | Public Speaking, (1) | 108 |
| | | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Draw. and Met. Constr., (4) | 230 | Blowpipe Analysis, (1) | 223 |
| Crystallography, (2) | 220 | Mineralogy, (3) | 221 |
| English, (2) | 93, 96 | Met. Constr. and Draw., (3) | 231 |
| Public Speaking, (1) | 109 | English, (2) | 94, 96 |

SUMMER TERM.

Mechanical Technology, 176.

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Strength of Materials, (4) | 142 | Metallurgy, (5) | 233 |
| Boilers, (1) | 173 | Steam Engine, (3) | 175 |
| Lithology, (2) | 250 | Geology, (4) | 254 |
| Ore Dressing, (3) | 289 | Quantitative Analysis, (4) | 369 |
| Blowpipe Analysis, (1) | 224 | | |
| Chemical Philosophy, (3) | 365 | | |
| Quantitative Analysis, (3) | 367 | | |

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 235 | Mech. of Machinery, (4) | 195 |
| Assaying, (3) | 383 | Metallurgical Design, (2) | 232 |
| Quantitative Analysis, (3) | 378 | Metallurgical Lab., (1) | 236 |
| Electrotechnology, (2) | 345 | Hydraulics, (3) | 151 |
| Materials, (2) | 143 | Engineer'g Laboratory, (1) | 192 |
| Economic Geology, (3) | 258 | Economics, (1) | 11 |
| Engineer'g Laboratory, (1) | 191 | Thesis, (6) | 240 |
| Economics, (1) | 10 | | |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN ELECTROMETALLURGY.

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first two years the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, mineralogy, drawing, and modern languages. In the third and fourth years this course agrees with the Metallurgical Engineering course in the inclusion of chemical analysis, chemical philosophy, metallurgy, ore dressing, boilers, steam engine, measurement of power, and the general culture studies; it differs from it by devoting less time to assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current resistance, electromotive force, inductive capacity, magnetic testing of iron, etc; Theory of Direct and Alternating-Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrolysis and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

Graduates in this course receive the degree of Electrometallurgist (El.Met.).

## THE COURSE IN ELECTROMETALLURGY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Qualitative Analysis, (3) | 363 |
| *or* French, (3) | 62 | Stoichiometry, (2) | 364 |
| Freehand Drawing, (2) | 125 | German, (3) | 73 |
| Hygiene, (2) | 279 | *or* French, (3) | 63 |
| English, (3) | 90, 91, 95 | English, (2) | 92, 95 |
| Gymnasium, (2) | 410 | Public Speaking, (1) | 108 |
| | | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Draw. and Met. Constr.,(4) | 230 | Blowpipe Analysis, (1) | 223 |
| Crystallography, (2) | 220 | Mineralogy, (3) | 221 |
| English, (2) | 93, 96 | Met. Const. and Draw.,(3) | 231 |
| Public Speaking, (1) | 109 | English, (2) | 94, 96 |

SUMMER TERM.

Mechanical Technology, 176.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Strength of Materials, (4) | 142 | Metallurgy, (5) | 233 |
| Boilers, (1) | 173 | Steam Engine, (3) | 175 |
| Ore Dressing, (3) | 289 | Quantitative Analysis, (4) | 369 |
| Chemical Philosophy, (3) | 365 | Alternating Currents, (2) | 315 |
| Quantitative Analysis, (3) | 367 | Electrical Eng., (2) | 334 |
| Blowpipe Analysis, (1) | 224 | Electrical Laboratory, (1) | 309 |
| Elec. and Magnetism, (2) | 307 | | |
| Electrical Laboratory, (1) | 308 | | |
| Dynamos and Motors, (2) | 332 | | |

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 235 | Metallurgical Design, (2) | 232 |
| Quantitative Analysis, (3) | 378 | Engineer'g Laboratory,(1) | 192 |
| Blowpipe Analysis, (1) | 224 | Electric Power, (2) | 342 |
| Engineer'g Laboratory,(1) | 191 | Dynamo Laboratory, (2) | 344 |
| Electric Lighting, (2) | 337 | Electrometallurgy, (1) | 238 |
| Dynamo Laboratory, (2) | 340A | Metallurgical Lab., (1) | 236 |
| Theory of Electrolysis, (1) | 237 | Economics, (1) | 11 |
| Electrical Laboratory, (1) | 314 | Thesis, (6) | 241 |
| Electromet. Lab., (1) | 239 | | |
| Economics, (1) | 10 | | |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN MINING ENGINEERING.

The object of this course is to prepare the student for practice in the field of Mining Engineering. As this field is naturally a very extensive one, a thorough education in all of the fundamental principles of technology and a special training in many branches of all of the technical courses are necessary. The course as laid down is therefore a very broad one, and the graduate will have had sufficient practice and training to enable him to enter not only upon the field of mining, but he can advantageously take up allied work in chemistry, geology, metallurgy, electro-metallurgy, chemical, civil, electrical and mechanical engineering.

The principal objects in view, however, are that he may be enabled,—

First. To make surface and underground surveys, and to map the topography and geology of a region.

Second. To readily recognize the mineral bodies encountered on a survey; to value and report on mineral outcrops and properties; and to analyze substances by wet, dry, or blowpipe methods, rather from the economic standpoint of the mining engineer than from the analytical one of the chemist.

Third. To make mining, metallurgical, or allied designs to meet the requirements of given cases, and to enter upon the construction of the same.

After having laid a thorough foundation in English, Public Speaking, Modern Languages, Mathematics, and Physics, the ability to execute the first of the preceding objects is secured by courses in land, topographic, and mine surveying and field geology; the second, by laboratory work in crystallography, mineralogy, microscopic petrography, chemical analysis, assaying, and blowpiping, and by courses in economic geology, prospecting, and the valuation of properties; the third, by extensive courses in strength of materials, graphical statics of trusses and mechanisms, hydraulics, boilers, steam engine, measurement of power, mining engineering, ore dressing, coal preparation, metallurgy, electro-metallurgy, and electro-technology, supplemented by visits to mining, metallurgical, and other plants of special interest, which may furnish data for problems to be solved by courses

in design based upon extensive practice in drawing, construction, and graphical analysis.

The natural sciences of the course are taught in an eminently practical manner. The theory is first developed, and then fully illustrated in such a way that the student is carried forward, noting, identifying, and comparing as he proceeds. Chemistry begins with a series of lectures on general chemical theory, supplemented by practice in the laboratory; the subject is continued by Qualitative and Quantitative Analysis,—parallel with the first of which is taught Stoichiometry; Assaying then follows. The entire work covered includes the analyses, by wet and dry methods, of the common ores, fluxes, coals, solid and gaseous metallurgical products. Hygiene is given by a course of lectures and recitations; exercise in the Gymnasium under the supervision of a competent director is required. In Physics the theory is supplemented by laboratory work in Mechanics, Heat, Electricity and Magnetism, Light and Sound. In Crystallography he handles accurately-made models, measures the angles, works out the symmetry, and from necessary data draws the crystal according to given methods. In Mineralogy he handles carefully selected specimens, and after learning the methods of identification by physical properties, is taught to apply these to more difficult types and to check the same by blowpipe tests. In Petrology he first learns to identify the common rock-forming minerals by microscopic methods and is thus enabled to readily recognize the constituents of those rocks which are too fine grained to be correctly determined by the eye. He then studies the grouping of these minerals into the characteristic rock textures and is enabled by laboratory and field practice to recognize all of the main types of rocks. In Geology, he learns the forms and structures which are characteristic of the rock masses that form the earth's crust and the various forces which operate to alter and deform them. This is followed by a brief review of the historical aspect of geology dealing chiefly with fossil life of the earth and its application to the determination of the age of strata. By practice in the field he then learns the methods by which rock formations are accurately mapped. Biology, apart from its value as a study, is given with the object of leading the student to an intelligent understanding of Historical Geology. For this purpose he becomes acquainted with the study of living organisms and takes up in succession the structure, development, origin and distribution of animals. In Economic Geology he learns the

theories of the formation of cavities in rocks and their relation to metalliferous deposits, together with a discussion of the manner in which ores have been deposited. This is followed by lectures and recitations on the structure, geological horizon and geographic distribution of the principal metallic and non-metallic deposits of the United States and Canada.

The technical branches of the course are also presented in a very practical manner. The course in Drawing begins with free-hand sketching, particular attention being given to the drawing of such objects as bear upon future work. Parallel with the preceding is the course in Mechanical Drawing; the student learns the use of instruments, makes drawings of machine parts of simple construction, makes tracing and blue prints, and solves problems in intersections and developments. In Metallurgical Construction he becomes familiar with metallurgical plant by making drawings and sketches of parts of the same. In Strength of Materials he learns the theory which governs the elasticity and strength of all the common materials and forms of the same which are used in constructions. In Hydraulics the flow of water is fully discussed, and Hydromechanics is dwelt upon. In Boilers the common types and accessories are fully treated; the course in Steam Engine deals with the subject in a complete manner. Work in the Engineering Laboratory supplements the two preceding subjects. The courses in Mechanics of Machinery and Graphic Statics enable him to analyze graphically the forces and stresses to which machines and trussed structures are subjected. In Metallurgy the general principles of the subject, embracing fuels, furnaces, processes, etc., are thoroughly presented, followed by the metallurgy of iron and steel, and by that of copper, lead, silver, gold, zinc, mercury, and aluminium. In Electrometallurgy the student is familiarized with the practical applications of electricity to metallurgical processes. Electrotechnology reviews the principles of Electricity and Magnetism as bearing upon dynamo-electric machinery, and embraces the study of the industrial applications of electricity which are of particular value to the mining engineer. The Summer Schools in Land, Topographic, and Mine Surveying, of four weeks each, enable the student to give his undivided attention to the practical operations involved therein. The last named, being conducted in the mining regions, not only gives him practice in mine surveying, mine railroad work, and field geology, but enables him to study mining opera-

tions, and to make sketches of parts of mining plant, which may be subsequently utilized in the mining design of the year following. The subject of Mining Engineering is covered by a series of courses extending through four terms, in which the following sub-divisions are taken up, viz., prospecting, boring, mining, transportation, drainage, ventilation, lighting, accidents, dressing, mine construction and mine administration. In Mining and Metallurgical Design the student embodies the foregoing principles and makes designs and working drawings of mining and metallurgical plant to fulfill given conditions.

The facilities for the study of economic geology and mining are almost unequaled, as within easy reach are mines of zinc ore, paint ore, limonite, magnetite, block and fossil hematites and the great anthracite coal fields of the State; while quarries of limestone, sand, slate, and cement lie immediately in the vicinity of the University. The mechanical and metallurgical facilities are almost equally good, as in the same borough are the great armor, gun and machine works of the Bethlehem Steel Company and the spelter and oxide works of the New Jersey Zinc Company.

Graduates in this course receive the degree of Mining Engineer (E.M.).

## THE COURSE IN MINING ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Qualitative Anal., (3) | 363 |
| *or* French, (3) | 62 | Stoichiometry, (2) | 364 |
| Freehand Drawing, (2) | 125 | Mech. Drawing, (1) | 291 |
| Mechanical Drawing, (3) | 291 | German *or* French, (3) | 73 *or* 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Land Surveying, 133.

## SOPHOMORE YEAR.

FIRST TERM.

| | |
|---|---|
| Analytic Geometry, (5) | 115 |
| Physics, (3) | 302 |
| Physical Laboratory, (1) | 304 |
| Crystallography, (2) | 220 |
| Quantitative Analysis, (3) | 367 |
| Metallurgical Constr., (3) | 231 |
| English, (2) | 93, 96 |
| Public Speaking, (1) | 109 |

SECOND TERM.

| | |
|---|---|
| Calculus, (5) | 116 |
| Physics, (3) | 305 |
| Physical Laboratory, (1) | 306 |
| Mineralogy, (3) | 221 |
| Blowpipe Analysis, (1) | 223 |
| Quantitative Anal., (3) | 371 |
| Petrology, (2) | 251 |
| English, (2) | 94, 96 |

SUMMER TERM.

Topographic Surveying, 134.

## JUNIOR YEAR.

FIRST TERM.

| | |
|---|---|
| Ore Dressing, (3) | 289 |
| Geology, (2) | 255 |
| Assaying, (3) | 383 |
| Boilers, (1) | 173 |
| Strength of Materials, (4) | 142 |
| Petrology, (2) | 252 |
| Blowpipe Analysis, (1) | 224 |
| Biology, (3) | 272 |
| Economics, (1) | 10 |

SECOND TERM.

| | |
|---|---|
| Mining Engineer'g, (2) | 280, 281 |
| Mining, (3) | 282 |
| Metallurgy, (5) | 233 |
| Geology, (2) | 256 |
| Steam Engine, (3) | 175 |
| Hydraulics, (3) | 151 |
| Economics, (1) | 11 |

SUMMER TERM.

Mine Surveying and Mine Railroads, 290.

## SENIOR YEAR.

FIRST TERM.

| | |
|---|---|
| Min. Eng., (4) | 283, 284, 285, 286 |
| Mine Constructions, (1) | 287 |
| Metallurgy, (4) | 235 |
| Electrotechnology, (2) | 345 |
| Mech. of Machinery, (2) | 177 |
| Graphic Statics, (2) | 144 |
| Engineer'g Laboratory, (1) | 191 |
| Economic Geology, (3) | 258 |

SECOND TERM.

| | |
|---|---|
| Mining Design, (4) | 292 |
| Mine Administration, (1) | 288 |
| Metallurgical Design, (2) | 232 |
| Electrometallurgy, (1) | 238 |
| Electrotechnology, (2) | 346 |
| Electrical Laboratory, (1) | 309 |
| Field Geology, (2) | 262 |
| Engineer'g Laboratory, (1) | 192 |
| Thesis, (3) | 293 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is, first, to give a broad education in general and scientific subjects, and second, to give training in those special subjects which are of most value in the equipment of the electrical engineer. The course includes a number of special studies in civil, mechanical and metallurgical engineering, and the graduate in Electrical Engineering is prepared, by the broad technical training which the course offers, not only to enter any of the branches of electrical engineering, but also to deal with the related problems in mechanical engineering, civil engineering, and metallurgical engineering.

The fundamental studies in mathematics, physics, chemistry, and language, including English, are given in the early part of the course. These subjects include the more essential features of a broad education, and they furnish a preparation for the more advanced scientific and technical training to follow.

Technical work is begun during the summer term at the end of the Freshman year, continuing through the Sophomore year in the study of Boilers, Steam Engines and Machine Design. The Junior and Senior years are devoted almost exclusively to advanced technical work. Two terms of Economics are required during the Junior year.

The study of Electricity and Magnetism during the first term of the Sophomore year constitutes an introduction to the industrial applications of electricity.

The special studies in Mechanical Engineering included in this course are: Machine Design, begun in the second half of the Freshman year, is continued for one year, and the student may elect advanced work in Machine Design throughout the Senior year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Boilers is given during the first term of the Sophomore year. Steam engine, following the study of boilers, is given during the second term of the Sophomore year. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in pattern-making, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Following the work in Mechanical Technology, the

study of Mechanics of Machinery, Machinery of Transmission, and Graphic Dynamics is pursued during the Junior year, Mechanics of Machinery and Graphic Dynamics being elective during the second term. Engineering Laboratory is given throughout the Senior year. In includes the calibration of engineering measuring instruments and the performance of practical tests on boilers, engines, and pumps.

The following special studies in Civil Engineering are included in this course: Construction is given throughout the Junior year, consisting of lectures on masonry, foundations, cements and mortars, walls, dams, arches, tunnels, and details of structures; Strength of Materials, given in the first term of the Junior year, is concerned with the theory of beams, columns and shafts, and the methods of computing and designing them; the subject includes practical work in the testing laboratory; Hydraulics, given in the second term of the Junior year, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes, and channels, naval hydromechanics, and hydraulic motors.

The special studies in Chemistry and Metallurgy are elective beginning with the second term of the Junior year, and continuing to the end of the Senior year. These studies include Stoichiometry and Qualitative Analysis, Theory of Electrolysis, and Electrolytic Laboratory work, general Metallurgy, and Metallurgy of Iron and Steel, Electrometallurgy (required), and Metallurgical Design.

The special studies in Electrical Engineering following Constructive Elements of Electrical Apparatus, and Electricity and Magnetism of the Sophomore year, are as follows: Advanced Theory of Electricity and Magnetism, begun in the first term of the Junior year, is devoted to the theory of electrical units and measurements, and to the advanced theory of electrostatics and the magnetism of iron. The accompanying laboratory work is devoted to precise electrical measurements, and the standardization and calibration of electrical measuring instruments. This theoretical work is followed by the study of the Theory of Alternating Currents during the second term of the Junior year and throughout the Senior year; this subject deals with the problems and methods of measurement which are peculiar to the modern practical applications of alternating currents, and with the theory underlying the action of the important types of alternating current machinery and transmission lines.

The study of Dynamo Electric Machinery is begun the first term of the Junior year and includes electrodynamics, the construction, operation, and testing of direct current dynamos and motors, with numerous problems to illustrate the application of principles to concrete cases. The subject of Electrical Engineering, beginning in the second term of the Junior year, deals with the more important industrial applications of electricity to lighting and power distribution.

Dynamo laboratory work, beginning in the second term of the Junior year, is continued for three terms. The instruction given by printed notes is supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make a large number of actual tests on direct and alternating current generators and motors, rotary converters, transformers, and other electrical apparatus. Carefully written reports of all tests made, with curves plotted from the observations, and discussion of results, are required.

The Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room, and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign, and one of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the technical French and German periodicals are included as part of the work of the Seminary.

Dynamo Testing is given by lectures and problems during the first term of the Senior year, and treats of standard and special methods of making commercial tests on dynamo machines, transformers, and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by the practical testing done in the dynamo laboratory.

Electric Lighting and Central Stations, given in the first term of the Senior year, and Electric Power Transmission and Traction, given in the second term of the Senior year, constitute an extension of the preliminary work given as Electrical Engineering during the second half of the Junior year. Included in these subjects are visits of inspection to electric light and power stations, and to manufacturing establishments in the Bethlehems and out of town. Central station tests are made and reports are required.

Electrical Design is begun in the first term of the Senior year and is pursued throughout the year. The work consists of a series of problems illustrating the application of electromagnetic laws to the calculation and proportioning of electrical machinery for a specified duty. Each student makes complete calculations and drawings for several types of apparatus, including electromagnets, direct and alternating current generators and motors, and transformers. The study of electrical design is intended to reënforce by concrete application the principles underlying the study of dynamo electric machinery.

Graduates in this course receive the degree of Electrical Engineer (E.E.).

Mature young men wishing to pursue special studies without being candidates for the degree will be given every reasonable opportunity in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 27.

A student in another college desiring to take the degree of Electrical Engineer at Lehigh University after graduation from college is strongly recommended in choosing his electives to anticipate as far as possible the studies of the Freshman and Sophomore years, as given in the following schedule, as well as those studies of the Junior and Senior years which are offered at his college. Specific regulations concerning admission to such advanced standing are given on page 25.

## THE COURSE IN ELECTRICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Draw. and Mach. Des., (3) | 170 |
| *or* French, (3) | 62 | German, (3) | 73 |
| Freehand Drawing, (2) | 125 | *or* French, (3) | 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

## SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Geometry, (5) | 115 | Calculus, (5) | 116 |
| Physics, (3) | 302 | Physics, (3) | 305 |
| Physical Laboratory, (1) | 304 | Physical Laboratory, (1) | 306 |
| Machine Design, (3) | 172 | Steam Engine, (4) | 174 |
| Boilers, (1) | 173 | French, (2) | 61 |
| French, (2) | 60 | *or* German, (2) | 71 |
| *or* German, (2) | 70 | English, (2) | 94, 96 |
| English, (2) | 93, 96 | | |
| Public Speaking, (1) | 109 | | |

SUMMER TERM.

Mechanical Technology, 176.

## JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Analytic Mechanics, (2) | 117 | Electrical Engineering, (2) | 333 |
| Elec. and Magnetism, (2) | 307 | Alternating Currents, (2) | 315 |
| Dynamos and Motors, (3) | 331 | Electrical Laboratory, (1) | 309 |
| Electrical Laboratory, (1) | 308 | Hydraulics, (3) | 151 |
| Strength of Materials, (4) | 142 | Construction, (2) | 138 |
| Mech. of Machinery, (2) | 177 | Economics, (1) | 11 |
| Construction, (2) | 137 | OPTIONS. | |
| Economics, (1) | 10 | Mech. of Mach. (3) | 183 |
| | | Graphic Dynamics, (3) | 180 |
| | | *or* | |
| | | Metallurgy, (3) | 234 |
| | | Stoichiometry, (2) | 364 |
| | | Qualitative Analysis, (1) | 363 |

## SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Theory of Alt. Cur., (2) | 316 | Theory of Alt. Cur., (3) | 317 |
| Dynamo Elec. Mach'y, (3) | 335 | Electrical Design, (2) | 341 |
| Electrical Design, (2) | 336 | Electric Power, (2) | 342 |
| Electric Lighting, (2) | 337 | Dynamo Laboratory, (2) | 344 |
| Dynamo Laboratory, (3) | 340 | Engineer'g Laboratory, (1) | 192 |
| Dynamo Testing, (1) | 339 | Electrical Seminary, (1) | 343 |
| Electrical Seminary, (1) | 338 | Electrometallurgy, (1) | 238 |
| Engineer'g Laboratory, (1) | 191 | Machine Design, (2) | 193 |
| OPTIONS. | | *or* Metallurgical Des., (2) | 232 |
| Machine Design, (2) | 189 | Thesis, (3) | 347 |
| *or* | | | |
| Theory of Electrolysis, (1) | 237 | | |
| Electrical Laboratory, (1) | 314 | | |

The figures in parentheses indicate the number of exercises per week

## THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine.

Instruction in Theoretical Chemistry is begun in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry, with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Theoretical Chemistry. In the first term of the Junior year there is a course of lectures and recitations on Theoretical Organic Chemistry.

Qualitative Anaylsis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the assay of gold and silver bullion are taught in the first term of the Senior year by lectures and laboratory work. The analysis of various commercial products is taken up in the second term of the Senior year, also the subjects of Sanitary and Agricultural Chemistry and Toxicology. Instruction is also given in Manufacturing Chemistry, Dyeing, Calico Printing, and Bleaching. Blowpipe analysis also is included in the course.

The practical work in Organic Chemistry is performed in the second term of the Junior year, with laboratory work and conference. There are courses of practical Microscopy and Electrochemistry, and Toxicology. Physical Chemistry is taught by text-book and laboratory work. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated, and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hempel's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas's, and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establisnments in this neighborhood and in and around New York City. A well-equipped photographic laboratory and dark rooms are provided, in which the students of the Chemical course receive practical instruction. There is also a course in Microscopy.

Graduates in this course receive the degree of Analytical Chemist (A.C.).

## THE COURSE IN CHEMISTRY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Qualitative Analysis, (6) | 362 |
| Chemistry, (2) | 360 | Stoichiometry, (2) | 364 |
| Chemical Laboratory, (2) | 361 | Physics, (2) | 300 |
| German, (3) | 72 | Physical Laboratory, (1) | 301 |
| *or* French, (3) | 62 | German, (3) | 73 |
| Freehand Drawing, (2) | 125 | *or* French, (3) | 63 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

### SOPHOMORE YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Chemical Philosophy, (3) | 365 | Physics, (3) | 305 |
| Quantitative Analysis, (6) | 366 | Physical Laboratory, (1) | 306 |
| Quant. Anal. Conf., (1) | 368 | Quantitative Analysis, (6) | 370 |
| Physics, (3) | 302 | Quant. Anal. Conf., (1) | 372 |
| Physical Laboratory, (1) | 304 | Theoretical Chemistry, (3) | 373 |
| English, (2) | 93, 96 | English, (2) | 94, 96 |
| Public Speaking, (1) | 109 | | |

### JUNIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Toxicology, (2) | 374 | Organic Chem. Lab., (6) | 380 |
| Quantitative Analysis, (6) | 375 | Org. Chem. Conf., (1) | 381 |
| Quant. Anal. Conf., (1) | 377 | Metallurgy, (5) | 233 |
| Organic Chemistry, (5) | 379 | Mineralogy, (3) | 221 |
| Crystallography, (2) | 220 | Blowpipe Analysis, (1) | 223 |
| Economics, (1) | 10 | Economics, (1) | 11 |
| English, (1) | 98 | Technical German, (1) | 394 |

### SENIOR YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Metallurgy, (4) | 235 | Industrial Chemistry, (3) | 385 |
| Assaying, (3) | 383 | Industrial Analysis, (3) | 386 |
| Industrial Chem. Lab., (3) | 382 | Ind. Anal. Conf., (1) | 387 |
| Lithology, (2) | 250 | Agricult'l Chem. Lab., (1) | 388 |
| Microscopy, (2) | 384 | Sanitary Chem. Lab., (1) | 389 |
| Blowpipe Analysis, (1) | 224 | Geology, (4) | 254 |
| Physical Chemistry, (1) | 390 | Electrochemistry, (1) | 392 |
| Phys. Chem. Lab., (1) | 391 | Electrochem. Lab., (1) | 393 |
| | | Electrometallurgy, (1) | 238 |
| | | Electromet. Lab., (1) | 239 |
| | | Thesis, (3) | 395 |

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN CHEMICAL ENGINEERING.

This course of study is designed to prepare students for the profession of the chemical engineer, engaged in the construction and management of manufacturing establishments involving chemical principles, such as sugar refineries, gas works, superphosphate works, bleacheries, dye works, oil refineries, fertilizer works, soap works, sulphuric acid plants, soda works, etc.

In addition to many of the subjects in the Course in Chemistry, it includes the subjects of elementary mechanics, boilers, steam engine, drawing and machine design, constructive elements of machinery, measurement of power, mechanics of machinery, mechanical technology, and work in the engineering laboratory. It also includes electricity and magnetism, dynamos and motors, and work in the electrical and dynamo laboratories.

In this course the training is essentially chemical and the graduates are primarily chemists with a good knowledge of mechanical engineering.

This equipment is considered more valuable for the chemical engineer than a fundamental training in engineering and a somewhat limited knowledge of chemistry, since the problems of the manufacturing chemist are not essentially mechanical ones. Although six years' work covering most of the studies of both the chemical and mechanical courses would be found advantageous for the chemical engineer, this shorter course, of four years, will be found to meet most of his requirements.

Graduates of this course receive the degree of Chemical Engineer (Ch.E.).

## THE COURSE IN CHEMICAL ENGINEERING.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Qualitative Analysis, (3) | 363 |
| *or* French, (3) | 62 | Stoichiometry, (2) | 364 |
| Freehand Drawing, (2) | 125 | German, (3) | 73 |
| Hygiene, (2) | 279 | *or* French, (3) | 63 |
| English, (3) | 90, 91, 95 | English, (2) | 92, 95 |
| Gymnasium, (2) | 410 | Public Speaking, (1) | 108 |
| | | Gymnasium, (2) | 411 |

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

## SOPHOMORE YEAR.

FIRST TERM.

Chemical Philosophy, (3) 365
Quantitative Analysis, (6) 366
Quant. Anal. Conf., (1) 368
Boilers, (1) 173
Physics, (3) 302
Physical Laboratory, (1) 304
English, (2) 93, 96
Public Speaking, (1) 109

SECOND TERM.

Theoretical Chemistry, (3) 373
Quantitative Analysis, (2) 371
Steam Engine, (4) 174
Draw'g and Mach. Des., (3) 170
Physics, (3) 305
Physical Laboratory, (1) 306
English, (2) 94, 96

SUMMER TERM.

Mechanical Technology, 176.

## JUNIOR YEAR.

FIRST TERM.

Quantitative Analysis, (2) 378
Organic Chemistry, (5) 379
Engineer'g Laboratory, (2) 178
Elec. and Magnetism, (2) 307
Electrical Laboratory, (1) 308
Dynamos and Motors, (2) 332
Machine Design, (3) 172
English, (1) 98

SECOND TERM.

Organic Chem. Lab., (6) 380
Org. Chem. Conf., (1) 381
Metallurgy, (5) 233
Engineer'g Laboratory, (1) 179
Electrical Eng., (2) 334
Electrical Laboratory, (1) 309
Technical German, (1) 394

SUMMER TERM.

Engineering Laboratory, 182.

## SENIOR YEAR.

FIRST TERM.

Industrial Chem. Lab., (3) 382
Assaying, (3) 383
Metallurgy, (4) 235
Microscopy, (2) 384
Engineer'g Laboratory, (1) 190
Mech. of Machinery, (2) 177
Physical Chemistry, (1) 390
Phys. Chem. Lab., (1) 391
Economics, (1) 10

SECOND TERM.

Industrial Chemistry, (3) 385
Industrial Analysis, (3) 386
Ind. Anal. Conf., (1) 387
Agricult'l Chem. Lab., (1) 388
Sanitary Chem. Lab., (1) 389
Electrochemistry, (1) 392
Electrochem. Lab., (1) 393
Electrometallurgy, (1) 238
Electromet. Lab., (1) 239
Economics, (1) 11
Thesis, (3) 395

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN GEOLOGY.

The course in Geology is almost the same as that in Mining Engineering up to the end of the Sophomore year and differs in only a few respects from it up to the end of the first term Junior year. It is designed for those who wish the thorough grounding of the engineering course, but whose tastes lead them into the natural sciences rather than into technical lines. The studies for the first two years are equally necessary for the thoroughly educated man in either, and by this arrangement the student is not required to decide which course he will follow until he has had an opportunity to test his own tastes and abilities.

After completing the course in Geology one year of graduate work will enable the student to secure the degree of Engineer of Mines and the graduate from the Mining Engineering course in the same way, by taking a year's work in the geological specialties as a major subject with the addition of a minor subject from another department, can complete the course in Geology and receive the degree of Master of Science.

The course meets the requirements of the teacher of the natural sciences, the field geologist, or the prospecting and exploring engineer, and furnishes especially a broad, thorough basis for the subsequent prosecution of original research. Throughout the entire four years the work gives a first-hand knowledge of the subjects taught and cultivates self-reliance and the powers of perception and exact reasoning. For those who may wish ultimately to become specialists in some one of the different branches of Geology this course is recommended with a year of graduate work at one of the larger Universities.

It includes the Mathematics and Physics taught in the technical courses, thus ensuring an ability to grasp and solve the problems of geological dynamics. A year's knowledge of French or German is necessary for entrance and this is continued by a year and a half of work in the same language. Two years' work in the other language is required during the Junior and Senior years, so that by the end of the course the student feels at home with foreign periodical literature in both French and German. Spanish also is taught during the Senior year.

A thorough knowledge of Surveying is considered at the present time indispensable to the field geologist, and the courses, being the same as those for the mining engineer, not only offer

a ready means of livelihood for young men just graduated, but afford practice in accurate mapping and give the proper basis for the interpretation of topography. The course in geodesy gives the methods of triangulation and the adjustment by least squares.

The preliminary courses in Crystallography, Mineralogy, Petrology, and Geology are the same as those given to the mining engineers and will permit the student with slight effort not only to recognize any of the constituents of the earth's crust, but to value the portion surveyed from an economic standpoint as it is adapted or not for mining operations. In addition to these are the more purely scientific courses. Throughout the Junior year three periods a week are set aside for field Geology to accompany the first year's work. The Petrology is continued through the second term Junior year; the student, having passed briefly over the general subject of Petrology, spends this time in studying some particular phases and becoming familiar with detailed methods which cannot be given in the briefer course. A course in advanced Geology devoted chiefly to Paleontology runs through the Senior year, a text-book being used and the student handling and identifying numerous invertebrate fossils. It is not designed to make a paleontologist, but to give that amount of systematic knowledge and ability to identify fossils which should be possessed by the stratigraphical geologist or to give a basis for one who wishes to pursue the subject further.

The several branches of Geology are so widely separated and require such different kinds of ability that in the second term Senior year an opportunity is given for the student to specialize. In the studies in Pennsylvania Geology he takes up some branch of the subject, reads the literature that bears upon it, and makes field studies over regions within reasonable distances. Original research is more properly left for graduate work, but this course is preparatory to it by showing the student the extent to which he must go before hoping to turn out new material. Some phases of the subject, however, embracing his own observations and deductions may properly be handed in for a thesis.

The ordinary courses in Geology are extended by excursions into the foundations of Botany, Zoölogy, and Biology, and supplemented by work in the field in the courses of Surveying and Physiography. The ability readily to determine the character and value of the ores and minerals met with is guaranteed by extended courses in Crystallography, Mineralogy, Megascopic and

Microscopic Rock Analysis, Economic Geology, and both Chemical and Blowpipe Analysis. The course in Chemistry includes assaying, quantitative wet analysis and the discussion of chemical problems, so that mineralogical formulae can be calculated from the results of analyses. The blowpipe courses cover qualitative and quantitative work. Economic Geology is taught in a thorough manner and applied by courses in refractory materials and general metallurgy which contain problems depending upon the composition and impurities of ores and gangues; and by a course in prospecting which treats of the presentation of ores and gangues at the surface and the rules for their discovery.

The courses in general Metallurgy and Hydraulics are of indirect scientific value to the geologist, since the first renders him familiar with the composition, behavior, and fluidity of slags, as well as with blast furnace reactions, and the course in hydraulics develops the principles of moving fluids with their practical applications and serves as an introduction to the subject of geologic dynamics.

Beginning in the first term Junior year the student is given the choice of making the course a purely scientific one, or one embracing a little more technical work, assaying and mining engineering being made an alternative option with field work in geology.

Graduates in this course receive the degree of Bachelor of Science (in Geology).

## THE COURSE IN GEOLOGY.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | German, (3) | 73 |
| *or* French, (3) | 62 | *or* French, (3) | 63 |
| Freehand Drawing, (2) | 125 | Qualitative Analysis, (3) | 363 |
| Mechanical Drawing, (3) | 291 | Stoichiometry, (2) | 364 |
| Hygiene, (2) | 279 | English, (2) | 92, 95 |
| English, (3) | 90, 91, 95 | Public Speaking, (1) | 108 |
| Gymnasium, (2) | 410 | Gymnasium, (2) | 411 |

SUMMER TERM.

Land Surveying, 133.

## SOPHOMORE YEAR.

FIRST TERM.

Analytic Geometry, (5) 115
Physics, (3) 302
Physical Laboratory, (1) 304
Crystallography, (2) 220
Chemical Philosophy, (3) 365
German, (2) 74
*or* French, (2) 64
English, (2) 93, 96
Public Speaking, (1) 109

SECOND TERM.

Calculus, (5) 116
Physics, (3) 305
Physical Laboratory, (1) 306
Mineralogy, (3) 221
Blowpipe Analysis, (1) 223
Petrology, (2) 251
English, (2) 94, 96

SUMMER TERM.

Topographic Surveying, 134.

## JUNIOR YEAR.

FIRST TERM.

Geology, (2) 255
Biology, (3) 272
Petrology, (2) 252
Blowpipe Analysis, (1) 224
Quantitative Analysis, (3) 367
Economics, (1) 10
French, (2) 60
*or* German, (2) 70
English, (1) 98

OPTIONS.

Field Geology, (3) 260
*or* Assaying, (3) 383

SECOND TERM.

Geology, (2) 256
Petrology, (2) 253
Quantitative Analysis, (3) 371
Metallurgy, (3) 234
Economics, (1) 11
French, (2) 61
*or* German, (2) 71
Botany, (2) 270

OPTIONS.

Field Geology, (3) 261
*or* Mining Eng., (2) 280, 281

SUMMER TERM.

Mine Surveying, 290.

## SENIOR YEAR.

FIRST TERM.

Geology, (4) 257
Economic Geology, (3) 258
Geodetic Surveying, (3) 136
Graphic Statics, (2) 144
French, (3) 62
*or* German, (3) 72
Spanish, (2) 80

SECOND TERM.

Physiography, (3) 259
Hydraulics, (3) 151
French, (3) 63
*or* German, (3) 73
Spanish, (2) 81
Thesis, (3) 264

OPTIONS.

Pennsylvania Geology, (5) 263
*or*
Field Geology, (2) 262
Pennsylvania Geology, (3) 263

The figures in parentheses indicate the number of exercises per week.

## THE COURSE IN PHYSICS.

The requirements for admission to this course are the same as the requirements for entrance to the School of Technology as explained on pages 23 and 24.

The object of the course is to give a broad education, together with sufficient training in mathematics, physics, and chemistry to enable the graduate to enter upon the career of teaching, or to undertake a post-graduate course in the physical sciences or in mathematics.

The required studies in the course include fundamental branches which are essential in every college course, advanced studies in mathematics and physics, and the introductory courses to electrotechnology: namely, the Theory of Dynamos and Motors and the Theory of Alternating Currents. Every teacher of physics and every advanced student of physics should be familiar with the peculiarly instructive exemplifications of physical principles which are to be found in the practical application of electricity and magnetism.

As far as possible the same electives are offered during the Junior and Senior years. The available electives of the second term depend, however, upon the work which has been done during the first term; for example, Mineralogy is open only to those who have taken Crystallography. The character and scope of these elective studies and of the various required studies in the course, are described in the List of Studies on pages 32 to 76.

Graduates in this course receive the degree of Bachelor of Science (in Physics).

## THE COURSE IN PHYSICS.

### FRESHMAN YEAR.

| FIRST TERM. | | SECOND TERM. | |
|---|---|---|---|
| Mechanics, (4) | 112 | Algebra and Trig., (5) | 113, 114 |
| Chemistry, (2) | 360 | Physics, (2) | 300 |
| Chemical Laboratory, (2) | 361 | Physical Laboratory, (1) | 301 |
| German, (3) | 72 | Qualitative Analysis, (2) | 363 |
| *or* French, (3) | 62 | Stoichiometry, (2) | 364 |
| Freehand Drawing, (2) | 125 | German, (3) | 73 |
| Hygiene, (2) | 279 | *or* French, (3) | 63 |
| English, (3) | 90, 91, 95 | English, (2) | 92, 95 |
| Gymnasium, (2) | 410 | Public Speaking, (1) | 108 |
| | | Gymnasium, (2) | 411 |

## SOPHOMORE YEAR.

FIRST TERM.

Analytic Geometry, (5) 117
Physics, (3) 302
Physical Laboratory, (1) 304
Chemical Philosophy, (3) 365
French, (2) 60
*or* German, (2) 70
English, (2) 93, 96
Public Speaking, (1) 109

SECOND TERM.

Calculus, (5) 116
Physics, (3) 305
Physical Laboratory, (1) 306
Descriptive Geometry, (3) 131
French, (2) 61
*or* German, (2) 71
English, (2) 94, 96

## JUNIOR YEAR.

FIRST TERM.

Analytic Mechanics, (2) 117
Elec. and Magnetism, (2) 307
Dynamos and Motors, (2) 332
Electrical Lab., (2) 308, 309
French, (3) 62
*or* German, (3) 72
Economics, (1) 10
English, (1) 98
(*Elective, four to six hours.*)
European History, (1) 20
Economics, (2) 12
Psychology, (2) 3
Politics, (2) 14
Crystallography, (2) 220
Organic Chemistry, (5) 379
Strength of Materials, (4) 142
Drawing, (4) 132

SECOND TERM.

Alternating Currents, (2) 315
Electrical Laboratory, (1) 309
French, (3) 63
*or* German, (3) 73
Economics, (1) 11
(*Elective, ten hours.*)
History, (2) 23
European History, (1) 20
Economics, (2) 13
Politics, (2) 15
Psychology, (2) 4
Hydraulics, (3) 151
Mineralogy, (3) 221
Metallurgy, (3) 234
Astronomy, (3) 118

## SENIOR YEAR.

FIRST TERM.

Theory of Light, (5) 310
Physical Laboratory, (2) 312
Physical Seminary, (2) 313
(*Elective, eight hours*)
European History, (1) 20
History, (2) 24
Economics, (2) 12
Psychology, (2) 3
Politics, (2) 14
Crystallography, (2) 220
Organic Chemistry, (5) 379
Strength of Materials, (4) 142
Practical Astronomy, (3) 119
Lithology, (2) 250
Drawing, (4) 132

SECOND TERM.

Theory of Heat, (4) 311
Physical Seminary, (2) 313
Thesis, (3) 318
(*Elective, eight hours*)
European History, (1) 20
History, (2) 23 or 25
Economics, (2) 13
Politics, (2) 15
Psychology, (2) 4
Hydraulics, (3) 151
Mineralogy, (3) 221
Geology, (4) 254
Metallurgy, (3) 234
Astronomy, (3) 118

The figures in parentheses indicate the number of exercises per week.

## GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

## DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

## THE UNIVERSITY MUSEUMS.

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Museum is located in the west end of Williams Hall, and contains collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world. There is also a duplicate set of the rocks collected by the Second Geological Survey of Pennsylvania.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

## UNIVERSITY LECTURES.

From time to time during the University year, distinguished members of the various professions are invited to lecture before the students upon those special subjects to which they have

given particular attention and upon which they are authorities.

The following lectures were given in this course during the years 1901-1902, and 1902-1903.

Mr. James B. Reynolds, "The Recent Municipal Campaign in New York."

Dr. Edward T. Devine, "The Housing of the Poor."

Mr. Frank Moss, "Morality and Politics."

Mr. H. T. Newcomb, "Recent Railway Combinations."

Mr. Samuel Gompers, "Labor's Struggles and Aspirations."

Hon. Edward M. Shepard, "The Use of Political Parties in Municipal Elections."

Mr. James B. Dill, "The Pros and Cons of the Trust Problem."

Rev. Charles C. Pierce, "The Situation in the Philippines."

Prof. Leo S. Rowe, "The Problem of Civil Government in Porto Rico."

Mr. Alfred Walter, "Technical Training as an Aid to Administrative Methods."

Mr. Theodore Marburg, "Shorter Hours for Labor."

Mr. Charles J. Bonaparte, "Civil Service Reform."

Mr. C. O. Mailloux, "Some Factors Bearing on the Career and Success of an Engineer."

Dr. T. M. Drown, "Some Facts and Fallacies About Drinking Water."

Prof. William T. Sedgwick, "The Sanitation of Cities."

Mr. Horace E. Deming, "Education and Democracy."

Mr. Howard W. Du Bois, "Camping Expeditions in the Rockies of British Columbia."

## THE CHEMICAL AND NATURAL HISTORY SOCIETY OF LEHIGH UNIVERSITY.

This Society was organized in the fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

## THE ENGINEERING SOCIETIES.

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

Recently the Civil Engineering and Mechanical Engineering sections have formed independent societies, with monthly meetings for the reading and discussion of papers relating to engineering subjects of their particular departments.

## THE ELECTRICAL ENGINEERING SOCIETY.

This Society was organized in 1887. Its object is to supplement the regular work in Electrical Engineering by the discussion of current topics in electricity and by lectures given under the auspices of the Society by engineers and by members of the corps of instructors in the department of Electrical Engineering.

## THE FORUM.

The Forum, a literary and debating society which meets semi-monthly, was organized in 1897. This Society has proved of great advantage to its members in the development of concise and logical thinking, in the promotion of ease before an audience, and in the acquirement of experience in parliamentary methods. Through this Society the University is represented in the Pennsylvania Intercollegiate Oratorical Union. An annual contest in debate is held with representatives of the literary societies of several other colleges. The Forum has justified its existence by the great increase in the amount of attention given, not only to training in oratory and debate, but also to those subjects of the day which are constantly discussed at its meetings.

## THE MATHEMATICAL CLUB.

This Club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University. It holds frequent meetings, at which papers are read and discussed by its members.

## THE Y. M. C. A. OF THE UNIVERSITY.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, a college graduate, being chosen from the student-body.

## FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 8, 1903, the twenty-fourth Founder's Day was celebrated. Addresses were then delivered at the formal opening of Williams Hall by Prof. E. H. Williams, jr., on "The Value of Geology and Biology in Technical Courses," and by Rossiter W. Raymond, Ph.D., of New York, N.Y., on "Dynamics and Ethics of Modern Engineering."

## UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day. The Rt. Rev. Alexander Mackay-Smith, D.D., Bishop-Coadjutor of Pennsylvania, was the preacher on Sunday, June 14, 1903, in the Packer Memorial Church.

## THESES.

Theses on the following subjects were prepared by candidates for degrees in 1903:

### FOR THE DEGREE OF MASTER OF ARTS.

MYRON JACOB LUCH, B.A., Macada.
The Continuity of the English Language.

### FOR THE DEGREE OF MASTER OF SCIENCE.

HENRY KEMMERLING, C.E., Scranton.
Some Applications of Weirstrass's Factor Theorem.

### FOR THE DEGREE OF BACHELOR OF ARTS.

ALFRED JOHN DIEFENDERFER, Bethlehem.
Experimental Study of the Fluctuations in Intensity and Speed of the Polyphase Rotating Field.

ARTHUR SIMON GILMORE, Williamsport.
The Development of Corporations.

NICHOLAS HUNTER HECK, South Bethlehem.
An Exposition of Certain Phases of the Ethical Problem as Treated by the Roman Stoics.

HARVEY ERNEST JORDAN, Coopersburg.
Arguments for Immortality from Socrates to Herbert Spencer.

CANBY GUY LORD, Williamsport.
Lucretius.

ELMER CLINTON PEARSON, Siegfried.
The Roman Senate.

THOMAS KILE SMITH, Richland Centre.
Bacchylides.

GEORGE ROSEBERY STULL, Ridley Park.
The Railroad Problem.

HENRY ROSCOE TRUMBOWER, Passer.
Ante-Reformation Relations of Church and State in England.

BODEWINE BERTRAND VAN SICKLE, Unionville, N. Y.
The Beginnings of the English Drama.

FOR THE DEGREE OF CIVIL ENGINEER.

RICHARD LATTIMER ADAMS, Harrisburg.
The Theory and Design of Combined Concrete and Steel Arches.

NORMAN ZABRISKIE BALL, Whippany, N. J.
Design of a Railroad Bridge Using Waddell's A Truss.

SYLVANUS A. BECKER, Nazareth.
Design of Turntable and Roundhouse for the Lehigh and New England Railroad.

WILLIAM SMITH BROWNELL, JR., Newport, R. I.
The Resistance of Piles and Bulkheads to Lateral Pressure.

GEORGE WISHARD BUTZ, Schuylkill Haven.
The Flow of the Little Lehigh and Jordan Creeks at Allentown.

THOMAS LEO CANNON, Allentown.
Design of Bridge Spans Across the Jordan Creek at Allen-Street, Allentown.

CESAR CASTELLANOS, Comitan, Chiapas, Mexico.
The Determination of Latitude and Longitude with the Engineer's Transit.

THOMAS KIMBLE REED GARDNER, Egg Harbor City, N. J.
Sewage Disposal in New Jersey.

WALTER DAVID GEBNET, Nazareth.
Plans and Estimates for Supplying Nazareth with Water from Bushkill Creek.

HUGH WHITMAN HAYNES, Allentown.
Design of the Approaches for the Proposed Structure at Allen Street, Allentown.

WILLIS ROBERT JORDAN, Bangor.
Plans and Estimates for Supplying Nazareth with Water from Camel's Hump Springs.

GEORGE MURRAY LEWIS, Seneca Falls, N. Y.
Experiments on the Imperviousness of Concrete and Clay.

GEORGE LOOMIS ROBINSON, Elmira, N. Y.
Review of the Mechanical Filter Plant at Elmira, N. Y.

JOHN DWIGHT ROGERS, Remsenburg, N. Y.
Design of a Steel Framed Office Building.

VICENTE SAUCEDO, Saltillo, Mexico.
Measurement of Stresses in Bridge Members by the Extensimer.

FRANCIS RAUCH SCHMID, Bethlehem.
Experiments to Determine the Coefficient of Elasticity for Concrete and Timber in Shear and in Tension.

ARTHUR VALL SPINOSA, San Juan, Porto Rico.
Design for a Concrete Dam Across the Lehigh River at Freemansburg with an Estimate of the Power Obtainable.

JOHN HECKEWELDER TRAEGER, Bethlehem.
Comparison of the Efficiency and Economy of Different Kinds of Coffer Dams.

WHITMELL PUGH TUNSTALL, Washington, D.C.
The Influence of Retempering and of Steaming upon the Strength of Cement.

HENRY RADCLYFFE WALTERS, Los Angeles, Cal.
Comparison of the Chemical Composition with the Physical Properties of Steel.

FOR THE DEGREE OF MECHANICAL ENGINEER.

GEORGE F. CASSEDY, Ashley.
Combined Boiler and Engine Test of the Cotton Mill of the Wilkes-Barre Lace Manufacturing Co.

CHAUNCY SHACKFORD CURTIS, New Castle.
Design for an Electric Ingot Stripper.

PAUL ARNOLD DEGENER, (with A. Frick,) New York, N.Y.
Test of R. P. Linderman's Power Plant at Fisher's Island,N.Y.

HARRY WEISER EISENHART, York.
Design of a Boiler for Freight Locomotives.

LOUIS WITHERS EVANS, Pottstown.
Test of a Compound Allis-Corliss Blast Furnace Blowing Engine.

SAMUEL PALMER FELIX, Schuylkill Haven.
An Efficiency Test of the Electric Lighting Station at Schuylkill Haven, Pa.

SAMUEL RANDOLPH FRAIM, Lancaster.
The Design of an Automatic Key Machine.

ARTHUR FRICK, (with P. A. Degener,) York.
Test of R. P. Linderman's Power Plant at Fisher's Island,N.Y.

PAUL GERHARD, East Orange, N.J.
The Plans and Estimates for a Machine Shop Arranged for the Construction of Lathes.

LOUIS TRACY GIRDLER, Jeffersonville, Ind.
Design of a Speed Launch.

ALFRED ROBINSON GLANCY, Washington, D.C.
Oil as a Fuel.

JOHN WALTER HERTZLER (with M. A. Walker,) Lancaster.
Test of an Ingersoll-Sergeant Air Compressor.

ELIAS ROBINS MORGAN, (with W. H. Myers,) Wilkes-Barre.
Designs for a Proposed Dyeing and Mercerizing Plant at Ithaca, N. Y.

WILLIAM HENRY MYERS, (with E. R. Morgan,) York.
Designs for a Proposed Dyeing and Mercerizing Plant at Ithaca, N.Y.

FREDERICK JAY PAYNE, Copenhagen, N.Y.
The Tempering and Testing of Modern Tool Steel.

DYER SMITH, Washington, D.C.
Equivalence of Mechanisms from Kinematic and Legal Points of View.

DAVID ROBERT SMITH, Pittsburg.
Test of a DeLaval Steam Turbine.

MARCUS ACHESON WALKER, (with J.W.Hertzler,) Washington, D.C.
Test of an Ingersoll-Sergeant Air Compressor.

FOR THE DEGREE OF MINING ENGINEER.

HIRAM SANBORN CHAMBERLAIN, JR., Chattanooga, Tenn.
Investigation of the Causes of the Mine Explosion at the Fraterville Mines, Coal Creek, Tenn.

EMORY THOMPSON MILLER, Louisville, Ky.
Relative Crushing Strength and Rapidity of Combustion of Metallurgical Fuels.

JOHN ROUTT REIGART, Washington, D.C.
Mine Haulage.

CHARLES HAMILTON THOMPSON, B.S., La Follette, Tenn.
A System of Surveying Coal Mines in Flat Seams.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

JOHN JOSEPH CORT, Latrobe.
An Investigation of the Thermal Conductivity of Various Steam Pipe Coverings by an Electrical Method and a Discussion of its Bearing on Central Station Economy.

SOLOMON W. GOLDSCHMIDT, Mount Carmel.
Experimental Study of the Variation of the Stray Power Losses in Direct Current Dynamo Machines.

CHESTER B. GRAHAM, (with R. Hunt,) Washington, D.C.
Experimental Study of a 7.5 Horse Power Induction Motor.

CHARLES FREDERICK HINCKLE, JR., Ardmore.
Experimental Study of an Open Coil Arc Lighting Dynamo.

RAYMOND HUNT, (with C. B. Graham,) Stockton, N.J.
Experimental Study of a 7.5 Horse Power Induction Motor.

CHARLES EDWIN MARKS, (with C.L'H.Ruggles,) South Beach,Conn.
Experimental Study of the Instantaneous Contact Method of Measuring Alternating Electromotive Force and Current.

NATHAN BENNETT ROBBINOVITZ, Brooklyn, N.Y.
Experimental Study of Liquid Rheostats.

COLDEN L'HOMMEDIEU RUGGLES, (with C. E. Marks,) So. Bethlehem.
Experimental Study of the Instantaneous Contact Method of Measuring Alternating Electromotive Force and Current.

ROYER NEWTON SKILLMAN, (with N. A. Wolcott,) Mount Healthy, O.
Tests on Alternate Current Transformers.

NEWTON AMOS WOLCOTT, (with R. N. Skillman,) Farmington, O.
Tests on Alternate Current Transformers.

FOR THE DEGREE OF ANALYTICAL CHEMISTRY.

GEORGE CARLTON BECK, Williamsport.
The Electric Preparation of Chemical Salts.

COURTLAND F. CARRIER, JR., Elmira, N.Y.
Isopropyl-phenyl Sulphonic Acid and its Derivatives.

ARCHIBALD ERNEST OLPP, Bethlehem.
Examination of Lehigh River Water.

## UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1904 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 17, 1903.

MUSIC.

PRAYER.

MUSIC.

Salutatory Oration.—"The Centralizing Influence of the Supreme Court."

ARTHUR SIMON GILMORE.

MUSIC.

Oration.—"Public Ownership of Railroads."

HARVEY ERNEST JORDAN.

Oration.—"The Object of Trades Unions."

ARTHUR VALL SPINOSA.

Oration.—"The Political Influence of the Assuan Dam."

NORMAN ZABRISKIE BALL.

MUSIC.

Alumni Address.—"The Social Discontent."

WILLIAM R. BUTLER, M.E.,
Class of 1870.

Valedictory Oration.—"The Social Effects of Electric Transportation."

JOHN JOSEPH CORT.

MUSIC.

Address to the Graduating Class,
THE REV. LYMAN ABBOTT, D.D.

Award of the Wilbur Scholarship of $200 to
SAMUEL HENRY FLEMING, of Philadelphia.
First in rank in the Sophomore Class.

The Williams Graduate Prize of $125, open to members of the classes of 1901, 1902, and 1903, was awarded to
GEORGE ROSEBERY STULL, of Ridley Park.

The Williams Gold Medal of $100 value, open to members of the Senior Class, was awarded to
HARVEY ERNEST JORDAN, of Coopersburg.

The Alumni Prizes of $25 each, for first honor men in the Junior Class in various departments, were awarded to

LESTER BERNSTEIN, of Philadelphia, in the Civil Engineering Department, and
HOWARD MALLET PREVOST MURPHY, of Philadelphia, in the Mechanical Engineering Department.

The Price Prize of $25 for English Composition, open to members of the Freshman Class, was awarded to
CHRISTIAN S. STOUFFER, of Sharpsburg, Md.

The Williams Prizes of $10 and $5 for Excellence in English Composition, open to members of the Sophomore Class, were awarded to

GEORGE PRYOR ENKE, of Nanticoke.
RAY C. KAUTZ, of Moweaqua, Ill.
EARL VICTOR PHELPS, of Washington, D.C.
EDWIN LOUIS RICH, of Washington, D.C.
CHARLES EDWARD ALDINGER, of York.
FRANK ANDERSON HENRY, of Annapolis, Md.
ARTHUR FREDERICK MURRAY, of Bethlehem.
PERCY RUTTER THOMAS, of Wilkes-Barre.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year were awarded as follows:

In Mathematics, to
EDWIN LOUIS RICH, of Washington, D.C.

In English, to
PAUL CLOKE, of Trenton, N.J.

In Physics, to

GEORGE STICKLE MERVINE, of Philadelphia.

Prizes of $5, to second honor men in the Sophomore year, were awarded as follows:

In Mathematics, to

EARLEY MCILHENNY JOHNSON, of Steelton.

In English, to

HORACE SCHULTZ SEIPT, of Worcester.

In Physics, to

CHARLES AUGUSTUS SHAFFER, of Harrisburg.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year, were awarded as follows:

In Mathematics, to

STEWART JOSEPH CORT, of Allegheny, and
CHRISTIAN S. STOUFFER, of Sharpsburg, Md.

In German, to

FRANK ALBERT VOCKRODT, of Pittsburg.

In French, to

MORRIS DEB. EVANS, of Reisterstown, Md.

In English, to

NEWTON GUY SMITH, of Pottstown.

Prizes of $25, $15, and $10, for Excellence in Oratory, open to members of the Sophomore Class, were awarded to

ALFRED WRIGHT ZAHNISER, of Mercer,
DEAN CORSA, of Washington, D.C., and
REXFORD ARCHIBALD HARROWER, of Swarthmore.

Prizes of $25, $15, and $10, for Excellence in Declamation, open to members of the Freshman Class, were awarded to

LUDWIG GARFIELD MEYER, of Erie,
BENJAMIN M. JOHNS, of Shickshinny, and
NEWTON GUY SMITH, of Pottstown.

## HONOR LIST, 1903.

### SENIOR HONORS.

Classical Course.

First: ARTHUR SIMON GILMORE, of Williamsport.
Second: HARVEY ERNEST JORDAN, of Coopersburg.

Latin-Scientific Course.

BOWDEWINE BERTRAND VANSICKLE, of Unionville, N.Y.

Civil Engineering Course.
First: Norman Zabriskie Ball, of Whippany, N.J.
Second: Cesar Castellanos, of Comitan, Mexico.

Electrical Engineering Course.
First: John Joseph Cort, of Latrobe.
Second: Raymond Hunt, of Stockton, N.J.

### JUNIOR HONORS.

Classical Course.
First: Thomas Archie Morgan, of Scranton.
Second: Arthur James Weston, of Scranton.

Latin-Scientific Course.
First: Herbert Joseph Hartzog, of South Bethlehem.
Second: Ralph Lucas Talley, of Williamsport.

Civil Engineering Course.
First: Lester Bernstein, of Philadelphia.
Second: John Clayton Snyder, of Harrisburg.

Mechanical Engineering Course.
First: Howard Mallet Prevost Murphy, of Philadelphia.
Second: Oliver Jacob Haller, of Pittsburg.

Electrical Engineering Course.
First: Stanley Sylvester Seyfert, of Strausstown.
Second: Jacob Lynford Beaver, of Phoenixville.

### SOPHOMORE HONORS.

In Mathematics.
First: Edwin Louis Rich, of Washington, D.C.
Second: Earley McIlhenny Johnson, of Steelton.

In English.
First: Paul Cloke, of Trenton, N.J.
Second: Horace Schultz Seipt, of Worcester.

In Physics.
First: Samuel Henry Fleming, of Philadelphia.
Second: George Stickle Mervine, of Philadelphia.
Third: Charles Augustus Shaffer, of Harrisburg.

### FRESHMAN HONORS.

In Mathematics.
First: Stewart Joseph Cort, of Allegheny.
Second: Christian S. Stouffer, of Sharpsburg, Md.

In German.

FRANK ALBERT VOCKRODT, of Pittsburg.

In French.

MORRIS DEB. EVANS, of Reisterstown, Md.

In English.

NEWTON GUY SMITH, of Pottstown.

Degrees were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

## THE WILBUR SCHOLARSHIP.

This scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

## THE HARRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200, which is to be devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

## THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS.

Friends of the late Frederick Mercur, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, have contributed and placed in the hands of the Trustees a fund, called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of four scholarships for free tuition in the University.

## THE ECKLEY B. COXE MEMORIAL FUND.

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $28,000, the interest of which is to be used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

## THE FRANK WILLIAMS FUND.

Mr. Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate to found a Fund, the income of which is to be lent to deserving students. The bequest becomes available for this purpose in 1905.

## WILBUR PRIZES.

A fund has been established, yielding an annual income of $100, by E. P. Wilbur, Esq., for distribution in prizes as the Faculty shall determine.

## THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of ideas. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intention not later than the first of April.

The subject for the prize essay in June, 1904, will be: "English and American University Life, Contrasted."

## ALUMNI PRIZES.

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, has with the consent of the contributors been diverted from this purpose and the income will in the future be used for prizes to members of the Junior Class. In June, 1904, two prizes of $25 each will be awarded to the first honor men of the course in Electrical Engineering and of the group comprising

the Junior students in Metallurgical Engineering, Electrometallurgy, and Mining Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

## ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of Lehigh University" established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following

### REGULATIONS.

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 21, 1903, with the following competitors:

Jacob H. Brillhart, of York.
Amos Henry Clauder, of Bethlehem.
Herbert Joseph Hartzog, of South Bethlehem.
Louis G. McCauley, of Susquehanna.
Thomas Archie Morgan, of Scranton.
William Henry Welker, of Red Hill.

The First Prize was awarded to L. G. McCauley; the Second to T. A. Morgan, and the Third to A. H. Clauder.

The judges were the Rev. J. Max Hark, of Bethlehem; the Rev. H. T. Quigg, of South Bethlehem, and Mr. Albert G. Rau, '88, of Bethlehem.

## WILLIAMS PRIZES IN ENGLISH AND ORATORY.

Prof. Edward H. Williams, jr., established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

### *Sophomore Composition Prizes.*

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amounts of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section where there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

*Senior Premiums.*

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or their committee, shall meet on the above date and at subsequent adjourned meetings and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded; but the sum of one hundred and fifty dollars, which is in the hands of the President to pay for them, shall be used by him in such manner as he shall see fit to encourage public speaking in the University.

If one or more dissertations are admitted as aforesaid, the Faculty, or their committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or their committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

If fewer than six candidates shall present dissertations, or fewer than six dissertations shall be admitted to the contest, the

whole, or such part of the sum of the above one hundred and fifty dollars as shall not be awarded at the close of the contest, and shall remain in the hands of the President, shall be used by him, as aforesaid, to further public speaking in the University, in any manner as he may see fit.

*Graduate Prize.*

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded. The sum of one hundred and twenty-five dollars in the hands of the President to pay this prize, in the event of its not being awarded, as aforesaid, shall be used by him to further public speaking, as aforesaid, unless, however, he may consider that he has already a sufficient fund in his hands for that purpose. In this latter case, he shall use

this above sum of one hundred and twenty-five dollars to encourage public debate in the University in any manner that he may see fit.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University; but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publications must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

# STUDENTS.

A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Clas.—Classical.
E.E.—Electrical Engineering.
El. Met.—Electrometallurgy.
E.M.—Mining Engineering.
L.S.—Latin-Scientific.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year:

## GRADUATE STUDENTS.

| | For Degree. | Residence. |
|---|---|---|
| Herbert Charles Dilliard, C.E., | M.S., | East Bangor. |
| Arthur Simon Gilmore, B.A., | M.A., | Williamsport. |
| Harvey Ernest Jordan, B.A., | M.A., | Bethlehem. |
| Archibald Ernest Olpp, A.C., | Spl., | Bethlehem. |
| Elmer Clinton Pearson, B.A., | M.A., | Siegfried. |
| Charles E. Rogers, C.E., | M.S., | South Bethlehem. |
| Lucien N. Sullivan, B.S., | M.S., | Bethlehem. |

## SENIOR CLASS.

### CLASS OF 1904.

| | Course. | Residence. |
|---|---|---|
| George Baily, | C.E., | Baltimore, Md. |
| Harvey Pettibone Barnard, | A.C., | Washington, D.C. |
| Charles Greene Baumgartner, | M.E., | Asbury Park, N.J. |
| Howard Green Bayles, | Met., | East Orange, N.J. |
| Jacob Lynford Beaver, | E.E., | Phoenixville. |
| Luther Becker, | M.E., | Schuylkill Haven. |
| Lester Bernstein, | C.E., | Philadelphia. |
| Robert Conner Bird, | E.E., | Weatherly. |
| Clinton Joel Bloss, | M.E., | Slatedale. |
| Harold Grant Bonner, | M.E., | Florida, N.Y. |
| Abraham George Borowsky, | E.E., | Philadelphia. |

| | Course. | Residence. |
|---|---|---|
| Gordon Hirsh Brandes, | E.E., | Philadelphia. |
| Jacob H. Brillhart, | C.E., | York. |
| Edward Claude Brown, | E.E., | Lock Haven. |
| Carleton Ward Buell, | C.E., | Plymouth, Conn. |
| Henry Freas Campbell, | C.E., | Williamsport. |
| John Jones Carl, | M.E., | Reading. |
| Samuel LeRoy Caum, | M.E., | Altoona. |
| Amos Henry Clauder, | C.E., | Bethlehem. |
| Horace Brooks Cleaveland, | E.E., | Washington, D.C. |
| Baxter Augustus Cornwell, | E.E., | Washington, D.C. |
| Milton Burnett Cory, | E.M., | Minneapolis, Minn. |
| Luis Cuesta, | C.E., | Guadalajara, Mex. |
| Alexander Lardner Dornin, | M.E., | Norfolk, Va. |
| William E. Dunbar, | C.E., | Harrisburg. |
| Harry Elias Edmonds, | C.E., | Elmira, N.Y. |
| Andrew Joseph Farabaugh, | E.M., | Altoona. |
| Louis Edward Farabaugh, | M.E., | Altoona. |
| John Warren Fisher, | C.E., | Williamsport. |
| William Warner Fitch, | A.C., | Rome, N.Y. |
| Clarence Jonas Frederici, | C.E., | Auburn. |
| Randolph Edward Spencer Geare, | M.E., | Washington, D.C. |
| Robert Stanley Goerlich, | Clas., | West Bethlehem. |
| George Kendrick Goodwin, | M.E., | Philadelphia. |
| John Jacob Grabe, | M.E., | Mitan, Russia. |
| Oliver Jacob Haller, | M.E., | Pittsburg. |
| Herbert Joseph Hartzog, | L.S., | South Bethlehem. |
| Nicholas Hunter Heck, B.A., (Lehigh University.) | C.E., | South Bethlehem. |
| Carl Swing Heritage, | C.E., | Bridgeton, N.J. |
| Ray Livingston Herrick, | E.M., | Westfield, Mass. |
| Jesse Bowman Hirst, | E.E., | Rosslyn, Va. |
| Samuel Henry Hodges, | M.E., | Norfolk, Va. |
| Robert Parke Hutchinson, | E.M., | Washington, D.C. |
| Henry Landon Jackson, | C.E., | Scranton. |
| Ralph Grant Johnson, | C.E., | Washington, D.C. |
| Michael Doland Jones, | C.E., | Rockaway, N.J. |
| Ramsey Daniel Kavanaugh, | M.E., | Williamsport. |
| Marcus Augustus Keck, | C.E., | Bethlehem. |
| Bert Moss Kent, | M.E., | Rome, N.Y. |
| Myron Hopkins Klar, | C.E., | Westfield, Mass. |
| Paul Theodore Krause, | A.C., | Bethlehem. |

| | Course. | Residence. |
|---|---|---|
| William Alexander Linn, | E.E., | Hamburg, N.J. |
| Charles William Lüders, | Clas., | Philadelphia. |
| William Thurston MacCart, | C.E., | Williamsport. |
| Louis Gheen McCauley, | M.E., | Susquehanna. |
| John McCleary, jr., | C.E., | Germantown. |
| Frank James McDevitt, | M.E., | Lancaster. |
| Warren Courtland Macfarlane, | M.E., | Louisville, Ky. |
| Edgar McCrorey Mack, | C.E., | Indiana. |
| John Meredith Miller, | C.E., | Sewickley. |
| Charles Law Moffatt, | M.E., | Pittston. |
| John Meiklejohn Monie, | C.E., | Pittston. |
| Thomas Archie Morgan, | Clas., | Scranton. |
| Clarence Rupert Morss, | L.S., | Scranton. |
| Leigh Merle Morss, | Clas., | Scranton. |
| Howard Mallet Prevost Murphy, | M.E., | Philadelphia. |
| William Updegraff Mussina, | M.E., | Williamsport. |
| Charles Leonard Orth, | E.E., | Washington, D.C. |
| Donald Julian Packer, | C.E., | Trenton, N.J. |
| Charles Roland Peebles, | Met., | Ashland, Ky. |
| John Franklin Pelly, | M.E., | Philadelphia. |
| Horace Weiser Pfahler, | A.C., | Holyoke, Mass. |
| Harold Shippen Pierce, | M.E., | Philadelphia. |
| William Calland Pollitt, | C.E., | Philadelphia. |
| John Howell Powell, | M.E., | Freeland. |
| Harold Patterson Reno, | M.E., | Pittsburg. |
| Stanley Sylvester Seyfert, | E.E., | Strausstown. |
| Stewart Sumner Shive, | E.E., | York. |
| Francis Peirce Sinn, | E.M., | Germantown. |
| Walter Souder Slifer, | C.E., | Lansdale. |
| John Clayton Snyder, | C.E., | Harrisburg. |
| Ralph Lucas Talley, | L.S., | Williamsport. |
| Jesse Waggener Underwood, | M.E., | Washington, D.C. |
| Richard Wahle, | E.E., | Buffalo, N.Y. |
| George J. Walz, | E.E., | Harrisburg. |
| Swinton Ball Waring, | C.E., | Charleston, S.C. |
| William Henry Welker, | A.C., | Red Hill. |
| Arthur James Weston, | Clas., | Scranton. |
| Emery Stone Whitney, jr., | C.E., | Bethlehem. |
| Ray Franklin Wunderly, | C.E., | Nazareth. |
| Charles Ernest Yost, | C.E., | Middletown. |

## JUNIOR CLASS.

### CLASS OF 1905.

| | Course. | Residence. |
|---|---|---|
| William Aaron Bachman, | M.E., | South Bethlehem. |
| Harold Provost Balston, | M.E., | Flushing, N.Y. |
| Wilson S. Barley, | C.E., | Steelton. |
| Azzel Clark Bennett, | M.E., | Oneida, N.Y. |
| Ben Crandall Bentley, | C.E., | Jackson, O. |
| John Daniel Berg, | M.E., | Pittsburg. |
| Lewis Samuel Birely, | C.E., | York Road, Md. |
| Louis Frederick Blume, | E.E., | Philadelphia. |
| Robert Amos Boehringer, | C.E., | Reading. |
| Walter Emerson Brown, | C.E., | Mattituck, N.Y. |
| Frank Horace Browning, | M.E., | Washington, D.C. |
| William Wentworth Brush, | C.E., | Washington, D.C. |
| Algernon Raymond Burchsted, | M.E., | Wollaston, Mass. |
| Charles Ely Butz, | E.E., | Allentown. |
| Niles Chapman, | M.E., | Bethlehem. |
| Herbert Ashmun Church, | C.E., | Washington, D.C. |
| Arthur Stevenson Clay, | C.E., | Holmesburg. |
| Clarence Edward Clewell, | E.E., | Winston-Salem, N.C. |
| Paul Cloke, | E.E., | Trenton, N.J. |
| Dean Corsa, | E.M., | Washington, D.C. |
| Joseph Frederick Cottrell, | M.E., | Danville. |
| John Adlum Dent, | M.E., | South Bethlehem. |
| Emil August Droll, | M.E., | Plainfield, N.J. |
| Arthur Edgar, | A.C., | Scranton. |
| George Pryor Enke, | M.E., | Nanticoke. |
| William Lawrence Estes, jr., | L.S., | South Bethlehem. |
| Samuel Henry Fleming, | E.E., | Philadelphia. |
| John Howard Ford, | E.E., | Pittsburg. |
| John Marvin Fouse, | E.M., | Pittsburg. |
| Nevin Elwell Funk, | E.E., | Bloomsburg. |
| Lyle Ray Garrison, | A.C., | Yellow Springs, O. |
| Albert Wesley Gaumer, | C.E., | Trooper. |
| J. Newlin Gawthrop, jr., | M.E., | Wilmington, Del. |
| Thomas Bragg Gilliam, | M.E., | Petersburg, Va. |
| Roger Samuel Stockton Guerber, | C.E., | Bethlehem. |
| Nathaniel Cole Harrison, | M.E., | Petersburg, Va. |
| Rexford Archibald Harrower, | C.E., | Swarthmore. |

| | Course. | Residence. |
|---|---|---|
| Cameron Douglass Hayes, | E.E., | Ballston, Va. |
| Walter Hilleroy Henderson, | C.E., | Rockville, Md. |
| William Homer Hendricks, | Met., | Hummelstown. |
| Nerias Henry, | E.E., | Seven Valleys. |
| Samuel Hess, | M.E., | Hellertown. |
| Robert Garnett Hodgkin, | L.S., | Falls Church, Va. |
| Henry William Hoeke, | M.E., | Washington, D.C. |
| George Michael Hornberger, | M.E., | Danville. |
| Elmer Barr Hostetter, | M.E., | Landis Valley. |
| Earley McIlhenny Johnson, | E.M., | Steelton. |
| Fred A. Johnson, | M.E., | Bethlehem. |
| John Taggart Jones, | M.E., | New Castle. |
| Ray C. Kautz, | E.M., | Moweaqua, Ill. |
| Robert Alfred Kinne, | C.E., | South Windham, Conn. |
| Ralph G. Kirk, | Met., | Harrisburg. |
| William Corson Kline, | C.E., | North Wales. |
| Harry Oscar Koch, | C.E., | Tamaqua. |
| Michael Henry Kuryla, | M.E., | Elmira, N.Y. |
| George W. Landrus, | E.M., | Wellsboro. |
| Will Henry Larkin, | M.E., | Butler. |
| Ernest Clifford Laudenberger, | M.E., | Freemansburg. |
| James Fulton Leonard, | C.E., | Salisbury, Md. |
| William Henry Lesser, | M.E., | Upper Lehigh. |
| William Henry Lynch, jr., | C.E., | Harrisburg. |
| Harry Cuthbertson Marshall, | M.E., | Allegheny. |
| Wallace Martin, | Clas., | Paterson, N.J. |
| James Alexander Mease, | M.E., | Bethlehem. |
| José M. Mendoza, | M.E., | Lima, Peru. |
| Norman Nathaniel Merriman, | L.S., | South Bethlehem. |
| George Stickle Mervine, | E.E., | Philadelphia. |
| Thomas Benjamin Mickley, | E.E., | Balliettsville. |
| Arthur Frederic Murray, | M.E., | Bethlehem. |
| Clarence Herr Ohlwiler, | A.C., | Altoona. |
| Hugh Pigott Oram, | C.E., | Washington, D.C. |
| Harry Laffayette Pentz, | C.E., | Montoursville. |
| Earl Victor Phelps, | E.E., | Washington, D.C. |
| Harry Weiser Protzeller, | E.E., | Hokendauqua. |
| George Kunkel Reel, | Met., | Harrisburg. |
| Richard Roy Renner, | C.E., | Sharpsburg, Md. |
| Edwin Louis Rich, | E.E., | Washington, D.C. |
| John A. Ruddy, | C.E., | Scranton. |

| | Course. | Residence. |
|---|---|---|
| Francis C. Ryan, | Met., | Harrisburg. |
| Charles Edgar Ryder, | C.E., | Norristown. |
| George Henry Schaeffer, | E.E., | Reading. |
| Edgar Henry Schmidt, | C.E., | White Haven. |
| William Russell Schnabel, | C.E., | Bethlehem. |
| Carl Theodore Schwarze, B.S., (Cooper Union.) | C.E., | New York, N. Y. |
| Alan deSchweinitz, | L.S., | Mechanicsburg. |
| James Alton Seacrest, | C.E., | Upton. |
| Horace Schultz Seipt, | C.E., | Worcester. |
| Charles Augustus Shaffer, | M.E., | Harrisburg. |
| Jonathan Emmett Sheesley, | L.S., | Penbrook. |
| Joseph Shema, | C.E., | Baltimore, Md. |
| George Henry Shenberger, | M.E., | Manchester. |
| Maynard Parker Shoemaker, | M.E., | Tenallytown, D.C. |
| George Arthur Sisson, | C.E., | Big Rock, Ill. |
| Alfred Pollitt Smith, | C.E., | Baltimore, Md. |
| Richard Hendon Smith, | E.E., | Philadelphia. |
| Frank Bausman Snyder, | M.E., | Mount Joy. |
| Ned Herbert Snyder, | M.E., | Harrisburg. |
| Oran Charles Snyder, | M.E., | Bethlehem. |
| Persifor Gybbon Spilsbury, | E.M., | Trenton, N.J. |
| Harold Tuttle Stearns, | M.E., | Wilkes-Barre. |
| Christian E. Stiver, | M.E., | Nazareth. |
| John Ellsworth Stonebraker, | E.E., | Hagerstown, Md. |
| George Levick Street, jr., | M.E., | Richmond, Va. |
| Richard Ryland Thompson, | C.E., | Cape May, N.J. |
| Russell Raymond Throp, | M.E., | Trenton, N.J. |
| William J. von Borries, | E.M., | Louisville, Ky. |
| John Russell Wait, | M.E., | Roselle, N.J. |
| Harry Samuel Walker, | M.E., | South Bethlehem. |
| John Henley Walker, A.B., (Randolph-Macon College.) | C.E., | Walkerton, Va. |
| Clarence Bailey White, | A.C., | Philadelphia. |
| Albert Jones Willis, | C.E., | Philadelphia. |
| James Hunter Wily, | E.E., | Pughtown. |
| James Harold Wolfe, | M.E., | Philadelphia. |
| Charles Harold Young, | Clas., | Floyd, N.Y. |
| Albert Wright Zahniser, | M.E., | Mercer. |

## SOPHOMORE CLASS.

### CLASS OF 1906.

| | Course. | Residence. |
|---|---|---|
| Edward Shultz Adams, | M.E., | Williamsport. |
| Charles Edward Aldinger, | M.E., | York. |
| Theodore Robison Angle, | M.E., | Danville. |
| Addison Cooke Armstrong, | C.E., | New York, N.Y. |
| Charles Luther Bachman, | M.E., | South Bethlehem. |
| William Mace-Douglas Barnes, | E.M., | Brooklyn, N.Y. |
| Calvin Barwis, | C.E., | Pittsburg. |
| Mead Reginald Beck, | Clas., | Bethlehem. |
| Warren Riegel Bell, | A.C., | Harrisburg. |
| Allen Thomas Blake, | C.E., | Albion, N.Y. |
| Edgar Ashton Borhek, | C.E., | Bethlehem. |
| David H. Brillhart, | C.E., | York. |
| Aubrey Levis Broomall, | E.E., | Cheyney. |
| Joseph Anthony Buch, | C.E., | Santiago, Cuba. |
| Walter Spaulding Buck, | E.E., | Harrisburg. |
| Harvey Miller Burkey, | El.Met., | Reading. |
| Halsted Woodrow Caldwell, | E.M., | New York, N.Y. |
| Morton Hazen Chase, | M.E., | Philadelphia. |
| Joseph Reed Chew, | C.E., | Millville, N.J. |
| Douglass Meeker Clawson, | E.E., | Mount Vernon, N.Y. |
| Chester Philip Clingerman, | M.E., | Altoona. |
| Arthur Basil Conner, | A.C., | Westfield, Mass. |
| Charles Ernest Conway, | M.E., | Baltimore, Md. |
| Stewart Joseph Cort, | El.Met., | Allegheny. |
| William Walton Crawford, | E.E., | Richmond, Va. |
| John Summerfield Crowther, jr., | M.E., | Cockeysville, Md. |
| Alfred Warren Cupitt, | M.E., | Germantown. |
| Hart Blayney Daugherty, | C.E., | Indiana. |
| Alfred Paul Davidson, | E.E., | Cambra. |
| Dion Kanouse Dean, | M.E., | Rahway, N.J. |
| William Weatherspoon Delap, | El.Met., | Annapolis Royal, |
| Clyde Denlinger, | A.C., | Strasburg. [Nova Scotia. |
| Harry Cortland Dent, | M.E., | Allentown. |
| Charles B. Devlin, | A.C., | South Bethlehem. |
| Charles Victor Dietz, | E.M., | Lincoln, Neb. |
| John Cyrus Distler, | M.E., | Baltimore, Md. |
| Charles Dorrance, | E.M., | Dorranceton. |
| Robert Samuel Drummond, | M.E., | Philadelphia. |
| Wilton Adams Earnshaw, | E.M., | Lowville, N.Y. |

| | Course. | Residence. |
|---|---|---|
| Ralph Selden Edmondson, | C.E., | Titusville. |
| William Raymond Ehlers, | E.E., | Baltimore, Md. |
| Henry Frederick Eigenbrodt, | M.E., | Baltimore, Md. |
| Walter F. Elwood, | A.C., | Vandergrift. |
| Morris de Bertholette Evans, | E.M., | Reisterstown, Md. |
| Marcus Martin Farley, | C.E., | Trenton, N.J. |
| John Herbert Farrell, | E.M., | Marquette, Mich. |
| Thomas George Fear, | M.E., | Eckley. |
| Raymond Lamur Filbert, | E.E., | Lebanon. |
| Arthur Cobb Flory, | M.E., | Scranton. |
| Edward Staniford Foster, | E.E., | Bayhead, N.J. |
| Walter Edmund Frankenfield, | M.E., | Butztown. |
| Edwin R. Geisewite, | C.E., | Reading. |
| Charles Frederick Gilmore, | Clas., | Williamsport. |
| Edward Ralston Goldsborough, | C.E., | Frederick City, Md. |
| Thomas Leslie Gossling, | E.E., | Philadelphia. |
| Estep Tillard Gott, | C.E., | Scranton. |
| William Henry Grady, | E.M., | Rhone. |
| Augustine E. Greene, | M.E., | Bristol, Conn. |
| John Huston Clark Gregg, | C.E., | Catasauqua. |
| William Heyward Grimball, | M.E., | Charleston, S.C. |
| August Bernard Grubmeyer, | E.E., | Germantown. |
| Anselm Verner Lee Guise, | E.M., | New York, N.Y. |
| Roberto Gutierrez, | C.E., | Serdo Durango, Mexico. |
| Claude Benneville Hagy, | C.E., | Reading. |
| William Seibert Hammaker, | E.E., | Harrisburg. |
| Yellott Fitzhugh Hardcastle, | El.Met., | Easton, Md. |
| Charles John Haslam, | E.M., | Ishpeming, Mich. |
| Edwin Paul Hayes, | M.E., | Eufaula, Ala. |
| Frank Anderson Henry, | Ch.E., | Annapolis, Md. |
| Paul Henry Herman, B.A., (St. John's College.) | El.Met., | Baltimore, Md. |
| James Allen Hoffman, | M.E., | Allentown. |
| George Cookman Hogg, | E.M., | Baltimore, Md. |
| Edward Holljes, | M.E., | Baltimore, Md. |
| Frederick Roland Horne, | C.E., | Plainfield, N.J. |
| Jesse Edwards Humphreys, | C.E., | Philadelphia. |
| J. G. Hunt Isert, | M.E., | Louisville, Ky. |
| Gilbert Garfield Jacobosky, | C.E., | Wilkes-Barre. |
| Clarence Arthur Jacoby, | E.E., | South Bethlehem. |
| John Richard James, | M.E., | Wilkes-Barre. |

| | Course. | Residence. |
|---|---|---|
| Frank W. Jefferson, | M.E., | Chesapeake City, Md. |
| Benjamin M. Johns, | Clas., | Shickshinny. |
| George Robert Johnson, | E.E., | Bayhead, N.J. |
| Milton Day Kirk, | E.M., | Curwensville. |
| George Edmund Kite, | C.E., | Norristown. |
| Raymond Henry Kressler, | M.E., | Allentown. |
| Thomas Norman Lacey, | E.E., | Lititz. |
| Clifford Barnes Langstroth, | M.E., | Rahway, N.J. |
| William Romeyn Lathrop, | M.E., | Seneca Falls, N.Y. |
| Henry Quimby Layman, | M.E., | Baltimore, Md. |
| Harry Riley Lee, B.S., (Rutgers College.) | El.Met., | New Brunswick, N.J. |
| Jacob Frank Lessig, | M.E., | Ashland. |
| Harry Oliver Lister, | E.M., | Carbondale. |
| John Calvin Little, jr., | C.E., | Parkton, Md. |
| Charles Wells Lotz, | M.E., | Reading. |
| Clair Miller Loucks, | C.E., | York. |
| Paul Jacob Luckenbach, | C.E., | Bethlehem. |
| Thomas Harrison Lüders, | M.E., | Philadelphia. |
| Ray Hope McFetridge, | M.E., | Hokendauqua. |
| Benjamin Carl McClure, | M.E., | Coatesville. |
| Roswell Silas McMullen, | C.E., | Carbondale. |
| Edward Marius McNally, | M.E., | South Bethlehem. |
| Gilbert Peters McNiff, | E.M., | Harrisburg. |
| J. Terence McVey, | C.E., | Ephrata. |
| Paul Donald March, | M.E., | Harrisburg. |
| Daniel Alfred Maurer, | E.E., | Minersville. |
| Thomas Andrew Hammersley Mawhinney, | Clas., | Philadelphia. |
| Leopoldo Mercader, | C.E., | Aguadilla, Porto Rico. |
| Richard Mansfield Merriman, | C.E., | South Bethlehem. |
| John Galt Miller, | M.E., | Lyons, Kan. |
| Kenneth Mills, | C.E., | Washington, D.C. |
| Austin Wilford Moore, | El.Met., | Scranton. |
| Isaac Hawkins Moore, | E.E., | Wilkes-Barre. |
| Thomas Miller Myers, | E.E., | Baltimore, Md. |
| William Edward Nicholson, | C.E., | Elmira, N.Y. |
| Michael William Nolan, | M.E., | Carbondale. |
| John Howard Opp, | C.E., | Plymouth. |
| Willard Marsh Payne, | A.C., | Elmira, N.Y. |
| Nathaniel Ramsay Pennypacker, | E.M., | Haddonfield, N. J. |

| | Course. | Residence. |
|---|---|---|
| Harry Alexander Peyton, | E.M., | Washington, D. C. |
| John Franklin Powell, | Clas., | Allentown. |
| Jonathan Harry Price, | E.M., | Knoxville, Tenn. |
| Francis Rogers Pyne, | El.Met., | Elizabeth, N.J. |
| Joseph Walker Reed, | M.E., | Meyersdale. |
| Robert Bruce Rench, | E.E., | Hagerstown, Md. |
| Arthur Lee Rinehimer, | M.E., | Wilkes-Barre. |
| William Henry Roberts, | E.M., | Bethlehem. |
| Benjamin Trexler Root, | M.E., | York. |
| Philip Rainey Roper, | M.E., | Petersburg, Va. |
| Richard Julian Roszel, | E.E., | Welbourne, Va. |
| John Thomas Rowe, | C.E., | Hampton, Va. |
| Ray Philips Saffold, | E.M., | Washington, D. C. |
| Samuel Henry Salisbury, jr., | A.C., | Seneca Falls, N.Y. |
| Clarence M. Saxman, | M.E., | Latrobe. |
| Carleton Meredith Schoonover, | E.E., | West Bethlehem. |
| Oliver Paul Serfass, | E.E., | South Bethlehem. |
| Frank Myron Shaw, | M.E., | Williamsport. |
| Frank Perley Howe Sholly, | M.E., | Tyrone. |
| David Norman Showalter, | C.E., | South Bethlehem. |
| George Madison Smartt, | M.E., | Chattanooga, Tenn. |
| Newton Guy Smith, | C.E., | Pottstown. |
| Samuel Reuben Smith, | E.E., | South Bethlehem. |
| Thomas Kile Smith, B.A., (Lehigh University) | C.E., | Richland Centre. |
| Walter Crispell Smith, | A.C. | Kingston, N.Y. |
| Judson Gray Smull, | A.C., | Altoona. |
| Milton Ellis Spear, | E.E., | Baltimore, Md. |
| Howard Raymond Stocker, | C.E., | Reading. |
| Christian S. Stouffer, | E.E., | Sharpsburg, Md. |
| Samuel Strauss, | A.C., | South Bethlehem. |
| Edward Russell Tattershall, | C.E., | White Haven. |
| Talbot Todd, | C.E., | Baltimore, Md. |
| Charles Hook Tompkins, | C.E., | Washington, D.C. |
| Philip Huston Torrey, | C.E., | Fort Missoula, Mont. |
| Harold Reiss Tracy, | E.M., | Washington, D.C. |
| Alexander Liggat Tunstall, | M.E., | Washington, D.C. |
| Charles Nourse Underwood, | M.E., | Lancaster. |
| Philip Ricord VanDuyne, | Clas., | Newark, N.J. |
| Reenen Jacob van Reenen, B.A., (Univ. of Cape of Good Hope.) | C.E., | Seapoint, South Africa. |

| | Course. | Residence. |
|---|---|---|
| Frank Albert Vockrodt, | E.M., | Pittsburg. |
| Rudolph Walter Vossberg, | M.E., | Bethlehem. |
| John Harvey Wallace, | E.E., | Philadelphia. |
| Adoniram Judson Warlow, | C.E., | South Bethlehem. |
| Roger Kenneth Waters, | E.E., | Germantown, Md. |
| Shirley Sears Watkins, | E.E., | Mount Carmel. |
| Edgar C. Weinsheimer, | E.M., | Allentown. |
| Charles Wheatley, | L.S., | Bethesda, Md. |
| Foster Reed Wheeler, | C.E., | Spencer, Mass. |
| Charles Wesley Williams, | A.C., | Washington, D.C. |
| Edwin Clifford Williams, | C.E., | Washington, D.C. |
| Lee Porter Wray, | C.E., | Altoona. |
| Francis German Wrightson, jr., | C.E., | Easton, Md. |
| John James Young, jr., | C.E., | Williamsport. |

## FRESHMAN CLASS.

### CLASS OF 1907.

| | Course. | Residence. |
|---|---|---|
| William Drees Aiken, | C.E., | Bethlehem. |
| Walter Jacob Ammer, | M.E., | Baltimore, Md. |
| Harry Frazier Anders, | E.M., | Frederick, Md. |
| Frank Pursell Angle, | M.E., | Danville. |
| Louis Antonsanti, | M.E., | San Juan, Porto Rico. |
| Ralph S. Archibald, | E.M., | Washington, D.C. |
| Oliver Warren Badgley, | E.E., | Hackettstown, N.J. |
| George Milford Baker, | E.E., | Hagerstown, Md. |
| Andrew Provost Balston, | M.E., | Flushing, N.Y. |
| Carl George Barth, jr., | E.M., | Swarthmore. |
| George Ormandy Bason, | E.E., | Sayville, N.Y. |
| Fred Palmer Bates, | A.C., | Williamsport. |
| Robert Ashton Bayard, | M.E., | Washington, D.C. |
| William Silver Bayless, | E.E., | Baltimore, Md. |
| Grover Esidore Bear, | C.E., | Fogelsville. |
| Henry Charles Becker, | C.E., | Baltimore, Md. |
| Harry Linton Beggs, | C.E., | Reading. |
| José Penteado Bill, | Clas., | Harrisburg. |
| Charles William Blazer, | E.E., | Newton, N.J. |
| Atherton Bowen, | E.E., | Pottsville. |
| John Williams Boyer, | Clas., | Catasauqua. |

| | COURSE. | RESIDENCE. |
|---|---|---|
| Percy Douglas Brewster, | Ch.E., | East Orange, N.J. |
| William Elmer Bricker, | C.E., | Philadelphia. |
| Richard Guy Brindle, | E.E., | Belleville. |
| John André Brodhead, | M.E., | Bethlehem. |
| Paul Lorenzo Brooke, | C.E., | Pottstown. |
| Harry Guy Brown, | Ch.E., | Norfolk, Va. |
| Stanley Wardwell Brown, | M.E., | Wilkes-Barre. |
| DeCourcy Bettingfield Browne, | E.M., | Baltimore, Md. |
| Orlando Weathers Bump, | C.E., | Baltimore, Md. |
| William Roy Bunting, | C.E., | Pottstown. |
| Paul Edmund Butler, | Ch.E., | Wilkes-Barre. |
| Carl Ross Camp, | C.E., | Montrose. |
| Donald Argyle Campbell, | C.E., | Brooklyn, N.Y. |
| Matthew Axton Campbell, | M.E., | Wheeling, W.Va. |
| Frank Cannon, | C.E., | Allentown. |
| John Bruce Carlock, | E.M., | Youngstown, O. |
| Rollin Landis Charles, | L.S., | Allentown. |
| Herbert T. Clewell, | A.C. | South Bethlehem. |
| Rhoton Parrott Clift, | E.M., | Chattanooga, Tenn. |
| Edgar King Collison, | C.E., | Baltimore, Md. |
| Frederick Wales Conlin, | M.E., | Bethlehem. |
| Hicks Leslie Conrad, | C.E., | East Orange, N.J. |
| Eugene Corbett, jr., | Met., | Nashville, Tenn. |
| James Pigott Cronan, | E.M., | New Haven, Conn. |
| Robert Emmett Cullen, | C.E., | Williamsport, Md. |
| Claude Mahlon Daniels, | C.E., | Pottstown. |
| Wallace Dann, | E.E., | Washington, D.C. |
| Arthur Albert Davis, | C.E., | West Bethlehem. |
| Alfred Shaffner DeHuff, | E.E., | Lebanon. |
| Henry Daniel Desh, | M.E., | Bethlehem. |
| Samuel Ernest Doak, | E.M., | Philadelphia. |
| Ray Elwood Dorney, | A.C., | Allentown. |
| William Albert Draper, | C.E., | Washington, D.C. |
| Howard Adams Dudley, | M.E., | Wheeling, W.Va. |
| William Coppée Duncan, | E.M., | Ishpeming, Mich. |
| George Anthony Dunn, | C.E., | Philadelphia. |
| Herbert Pannebecker Dyson, | E.M., | New Providence. |
| George Clinton Edwards, | M.E., | Elizabeth, N.J. |
| William Everett Eshelman, | C.E., | Summerville. |
| John Rutty Eustis, | L.S., | New York, N.Y. |
| Oliver Morris Evans, jr., | C.E., | Lansdale. |

| | Course. | Residence. |
|---|---|---|
| Richard Clayton Evans, | Ch.E., | Rome, N.Y. |
| Charles Peter Eyrich, | C.E., | Reading. |
| Ambrose Joseph Fasenmyer, | C.E., | New Bethlehem. |
| Frank Gabriel Fear, | M.E., | Eckley. |
| Samuel Harvey Fredericks, | C.E., | Lock Haven. |
| Isadore James Freedman, | L.S., | Philadelphia. |
| Ernest Johnson Fuller, | C.E., | Brooklyn, N.Y. |
| Joseph Hamilton Galliher, | C.E., | Washington, D.C. |
| Theodore Nicholas Gill, jr., | E.M., | Washington, D.C. |
| Ralph John Gilmore, | Clas., | Williamsport. |
| Leon Brown Gladden, | E.E., | Rocks, Md. |
| Edgar Fredrick Gohl, | C.E., | Harrisburg. |
| Edward McConnell Goucher, | C.E., | Toronto, O. |
| LeRoy Townsend Grace, | C.E., | Goshen, N.J. |
| Rulon James Green, | E.E., | West Chester. |
| Montgomery James Greenough, | C.E., | Four Paths, Jamaica. |
| Clarence Hill Griffith, | E.E., | Utica, N. Y. |
| Henry Joseph Groeninger, | C.E., | Baltimore, Md. |
| Charles Aaron Gross, | C.E., | South Bethlehem. |
| Arnold Guerber, | C.E., | Allentown. |
| John Faber Hanst, | E.M., | Philadelphia. |
| Harry Kerr Hartzell, | A.C., | Allentown. |
| Philip Nichola Hartzell, | A.C., | Allentown. |
| Eugene MacCulloch Hayes, | C.E., | Louisville, Ky. |
| James Leslie Hays, jr., | E.E., | Trenton, N.J. |
| Frederick Calvert Heighe, jr., | E.M., | Baltimore, Md. |
| George Kurt Herzog, | El.Met., | Mickleton, N.J. |
| Alfred William Hesse, | E.M., | Wheeling, W. Va. |
| Stanley Walter Hill, | C.E., | Bethlehem. |
| William Corcoran Hill, | M.E., | Pittsburg. |
| August John Hoff, jr., | M.E., | Elizabeth, N. J. |
| Robert Alexander Hooke, | C.E., | Chattanooga, Tenn. |
| Langdon Wight Howard, | C.E., | Plainfield, N.J. |
| Gilbert Henry Hoyt, | M.E., | Poughkeepsie, N.Y. |
| Edgar Philemon Hulse, | M.E., | Washington, D.C. |
| Roger Hunt, | E.M., | Catasauqua. |
| William Hunter, | M.E., | Philadelphia. |
| William John Hutchinson, | A.C., | Englewood, N.J. |
| Lawrence Wetherill Janeway, | E.M., | Greensburg. |
| David William Jardine, | M.E., | Newington, Ontario. |
| Earle Frederick Johnson, | E.E., | Gracedale. |

| | Course. | Residence. |
|---|---|---|
| Ellwood Johnson, jr., | C.E., | Philadelphia. |
| Frank Ulrich Kennedy, | C.E., | Carlisle. |
| Gordon Eugene Kent, | C.E., | Rome, N.Y. |
| George Croney Kiefer, | C.E., | Baltimore, Md. |
| Edmund G. King, | C.E., | Pottsville. |
| Thomson King, | E.E., | Annapolis, Md. |
| Ralph Wilhelm Kinsey, | L.S., | Reading. |
| Stanley Bancroft Koch, | El.Met., | South Bethlehem. |
| Albert Edward Krause, | M.E., | Bethlehem. |
| Charles Theodore Kriebel, | E.M., | Allentown. |
| Robert Louis Lafferrandre, | A.C., | Sayville, N.Y. |
| Daniel Henry Lamke, | C.E., | Brooklyn, N.Y. |
| Chester John Langdon, | E.M., | Huntingdon. |
| Frank P. Laufer, | A.C., | South Bethlehem. |
| Alfred William Lawson, | E.E., | Pottsville. |
| Charles Henry Leaman, | M.E., | Reading. |
| Julian Albert Leonhard, | A.C., | Haledon, N.J. |
| Thomas Minor Lesher, | M.E., | Easton. |
| Earl Loomis, | C.E., | Wilkes-Barre. |
| John G. Loose, | M.E., | Palmyra. |
| Robert MacMinn, | C.E., | Williamsport. |
| Jeremiah Joseph McCarthy, | Clas., | Cattaraugus, N.Y. |
| William McCleary, | E.M., | Germantown. |
| Max McCullough, | E.M., | Washington, D.C. |
| James English McDevitt, | E.M., | Lancaster. |
| Harold Austin McIntosh, | C.E., | Highland, Kans. |
| William John McKee, | C.E., | Pittsburg. |
| JohnThos.AudenriedMcLaughlin, | M.E., | Thomas, Ala. |
| Donald MacLean, | C.E., | Bethlehem. |
| Philip Outerbridge McQueen, | C.E., | Washington, D.C. |
| Edward MacFarlane, | E.M., | Towanda. |
| Paul Mackall, | M.E., | Washington, D.C. |
| Arthur Barlow Marshall, | C.E., | Allegheny. |
| Albert Jacob Mayer, | M.E., | Johnstown. |
| Rodney Augustus Mercur, jr., | M.E., | Towanda. |
| William R. Meyers, | E.M., | Louisville, Ky. |
| Levin Alexander Moore, | M.E., | Bethlehem. |
| Rafael Morera, | M.E., | San Juan, Porto Rico. |
| Samuel Rea Morris, | M.E., | Pottstown. |
| Burton Gilbert Morss, | C.E., | Scranton. |
| Leoncio Mosquera, jr., | C.E., | Mayaguez, Porto Rico. |

| | Course. | Residence. |
|---|---|---|
| Jacob Oscar Mulford, | E.E., | Cedarville, N.J. |
| Coleman Murphy, | C.E., | Pittsburg. |
| Lawrence Bert Myers, | C.E., | Philadelphia. |
| Louis Compton Paine, | E.E., | New York, N.Y. |
| Percy Stuart Palmer, | C.E., | Plainfield, N.J. |
| Edwin Calvin Parkhurst, | M.E., | York. |
| Everard LeCompte Pattison, | C.E., | Baltimore, Md. |
| Joseph Irving Porter, | E.E., | Stonega, Va. |
| Robert Streeter Porter, | C.E., | Stonega, Va. |
| Henry James Prechtl, | Clas., | Elmira, N.Y. |
| Warren Albert Quadenfield, | El.Met., | South Bethlehem. |
| Andrew Carnegie Ramsay, | E.M., | Greensburg. |
| Lyman Arthur Ransehousen, | Ch.E., | Springfield, Mass. |
| Theodore Warwick Reed, | M.E., | Washington, D.C. |
| Joseph Benson Reynolds, | Clas., | New Castle. |
| George Hollingsworth Robinson, | L.S., | Uniontown. |
| Clarence Knight Roulston, | C.E., | Philadelphia. |
| Daniel Saenz, | Ch.E., | New York, N.Y. |
| Manuel Teofilo Saldaña, | E.E., | San Juan, Porto Rico. |
| Joseph Ralph Scarlett, | C.E., | Philadelphia. |
| NormanWillabi Henry Schafer,jr., | C.E., | Shamokin. |
| Martin Henry Schmid, | M.E., | Washington, D.C. |
| Truman Gross Schnabel, | Clas., | Bethlehem. |
| Edgar Schweitzer, | M.E., | Bethlehem. |
| John Denny Scott, | M.E., | Portland, Ore. |
| Thomas Richard Senior, jr., | C.E., | Washington, D. C. |
| Elmer Frederick Shaffer, jr., | M.E., | Philadelphia. |
| Francis Hamilton Sherrerd, | Met., | Buffalo, N.Y. |
| Cecil Goeffrey Shields, | E.E., | Nicholson. |
| Stanley Douglass Shimer, | M.E., | Bethlehem. |
| Elmer Ellsworth Shoemaker, | C.E., | Upton. |
| Charles Benedict Slitzer, | M.E., | Harrisburg. |
| Albert Carmen Smith, | E.E., | West Bethlehem. |
| Coe Louis Smith, | E.E., | Hamburg, N.J. |
| James Albert Smith, | M.E., | Newburgh, N.Y. |
| Martin Luther Hoffa Smith, | M.E., | Reading. |
| Matthew Lincoln Smith, | C.E., | Mount Carmel. |
| Shaler Gordon Smith, | C.E., | Baltimore, Md. |
| Earle Henry Snyder, | C.E., | Parryville. |
| Albert John Spaeth, | C.E., | Philadelphia. |
| Garnett Leigh Spratley, | M.E., | Petersburg, Va. |

| | Course. | Residence. |
|---|---|---|
| James Stather Stanford, | E.M., | Great Falls, Mont. |
| David Preston Stauffer, | E.E., | York. |
| Hugh Exton Steele, | M.E., | Baltimore, Md. |
| Minor Benson Stewart, | E.M., | Warren. |
| Bruce Milton Swope, | M.E., | Harrisburg. |
| Arthur S. Taylor, | Met., | Bethlehem. |
| Lewis Thomas, | C.E., | New Castle. |
| Walter Atwood Thomas, | E.M., | Worcester, Mass. |
| Edward Post Tooker, | E.M., | Port Jefferson, N.Y. |
| Wilbur Baird Topping, | E.M., | New York, N.Y. |
| George William Townsend, A.B. (Johns Hopkins Univ.) | C.E., | Baltimore, Md. |
| Geo. Washington LeRoy Travis, | C.E., | Flushing, N.Y. |
| Edgar Raymond Treverton, | E.E., | Carlisle. |
| Hiram Christ Troxel, | C.E., | Lock Haven. |
| Malcolm Henry Ulman, | A.C., | Williamsport. |
| Henry Clay Underhill, jr., | M.E., | East Aurora, N.Y. |
| Joseph Cole Utley, | M.E., | Hagerstown, Md. |
| Joseph Temple Waddill, | E.M., | Richmond, Va. |
| Lawrence Alexander Wall, | C.E., | Harrisburg. |
| Raymond Wadsworth Walters, | Clas., | Bethlehem. |
| George Harold Wartman, | A.C., | Allentown. |
| John Henry Westerbeke, | E.M., | West Sayville, N.Y. |
| Ira Benjamin Wheeler, jr., | M.E., | Elizabeth, N.J. |
| Andore Wiesenberg, | E.M., | South Bethlehem. |
| Chester Harvey Wilcox, | C.E., | Center Moriches, N.Y. |
| Thomas Wilkinson, | E.M., | New London, Conn. |
| David Sage Williams, jr., | M.E., | Ocala, Fla. |
| Carter Lindsey Wilson, | M.E., | Louisville, Ky. |
| Frederick James Wilson, | M.E., | Pittsburg. |
| William Slayton Wilson, | E.E., | Rochester, N.Y. |
| John Wood, jr., | M.E., | Pottsville. |
| Roy Beck Woodring, | Clas., | Allentown. |
| Lewis Eli Yingst, | C.E., | Philadelphia. |
| Robert Linthicum Young, | C.E., | Gaithersburg, Md. |
| George J. Zboyovsky, jr., | A.C., | South Bethlehem. |

## SPECIAL STUDENTS.

| | Course. | Residence. |
|---|---|---|
| Harlow Frederick Banfield, | M.E., | Beaver. |
| Walter Hammer Cunningham, | M.E., | Johnstown. |
| John Mason Dill, | E.M., | Bessemer, Ala. |
| Ben Garfield Evans, | E.E., | Mahanoy City. |
| Francis Henry Galvin, | E.M., | Jamaica Plains, Mass. |
| Davis F. Garber, | E.E., | Royersford. |
| Julius Reed Hall, | C.E., | Elmira, N.Y. |
| Frederick Gordon Hurst, | C.E., | South Bethlehem. |
| Edward Everett Johnston, | C.E., | Baltimore, Md. |
| George Paxson Jones, | C.E., | Phoenixville. |
| James Clinton Landefeld, | M.E., | Ashland. |
| Carl Emil Lilliestrand, | C.E., | Hvalfalla, Sweden. |
| John Nimé, | M.E., | Poley, Germany. |
| Thomas Windsor Peters, | E.E., | Annapolis, Md. |
| William Porter Poole, | M.E., | Wilmington, Del. |
| William Robert Shimer, | Met., | Easton. |
| Samuel Harrison Tilghman, B.A., (St. John's College.) | C.E., | Easton, Md. |
| William Harvey Tschappat, | E.E., | Bethlehem. |
| Eugene Eric Valk, | E.E., | Annapolis, Md. |
| Ernest Benjamin Walton, | C.E., | Pocomoke City, Md. |
| William Scott Watson, | M.E., | Williamsport. |

## SUMMARY OF STUDENTS BY CLASSES AND COURSES.

| | Graduates. | Seniors. | Juniors. | Sophomores. | Freshmen. | Specials. | Totals. |
|---|---|---|---|---|---|---|---|
| Classical | 3 | 5 | 2 | 6 | 9 | | 25 |
| Latin-Scientific | | 3 | 5 | 1 | 5 | | 14 |
| Civil Engineering | 2 | 31 | 33 | 46 | 73 | 7 | 192 |
| Mechanical Engineer. | 1 | 26 | 42 | 49 | 50 | 6 | 174 |
| Mining Engineering | | 5 | 7 | 22 | 33 | 2 | 69 |
| Metallurgical Eng. | | 2 | 4 | | 3 | 1 | 10 |
| Electrometallurgy | | | | 8 | 3 | | 11 |
| Electrical Engineering | | 14 | 18 | 27 | 26 | 5 | 90 |
| Analytical Chemistry. | 1 | 5 | 4 | 11 | 12 | | 33 |
| Chemical Engineering | | | | 1 | 6 | | 7 |
| Totals | 7 | 91 | 115 | 171 | 220 | 21 | 625 |

## SUMMARY OF STUDENTS BY STATES.

| | |
|---|---|
| Massachusetts | 9 |
| Connecticut | 5 |
| New York | 48 |
| New Jersey | 40 |
| Pennsylvania | 355 |
| Delaware | 2 |
| Maryland | 56 |
| District of Columbia | 38 |
| Virginia | 18 |
| West Virginia | 3 |
| North Carolina | 1 |
| South Carolina | 2 |
| Florida | 1 |
| Kentucky | 7 |
| Tennessee | 5 |
| Alabama | 3 |
| Ohio | 4 |
| Illinois | 2 |
| Michigan | 3 |
| Minnesota | 1 |
| Kansas | 2 |
| Nebraska | 1 |
| Montana | 2 |
| Oregon | 1 |
| Canada | 2 |
| Mexico | 2 |
| Cuba | 1 |
| Porto Rico | 5 |
| Jamaica | 1 |
| Peru | 1 |
| Sweden | 1 |
| Germany | 1 |
| Russia | 1 |
| South Africa | 1 |
| | 625 |

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R. F. Gadd, '93.
A. G. Galan, '95.
J. M. G. Galán, '98.
C. Gallardo, '02.
F. M. Gallardo, '97.
J. G. Gandia, '99.
T. J. Gannon, '96.
T. K. R. Gardner, '03.
M. W. Garman, '01.
H. M. Gassman, '01.
L. P. Gaston, '88.
W. Gates, jr., '88.
J. T. Gavan, '02.
C. W. Gearhart, '93.
F. B. Gearhart, '01.
W. B. Geiser, '02.
R. E. L. George, '98.
P. Gerhard, '03.
W. D. Gernet, '03.
E. A. Giberga y Galé, '95.
J. J. Gibson, '95.
P. D. Giess, '97.
*J. E. Gilbert, '78.
A. H. Gill, '00.
A. S. Gilmore, '03.
L. T. Girdler, '03.
T. M. Girdler, '01.
J. B. Given, '96.
T. Gjertsen, '92.
F. W. Glading, '94.
A. R. Glancy, '03.
*A. M. Glassel, '77.
P. W. Gleason, '02.
*J. B. Glover, jr., '88.
E. G. Godshalk, '95.
H. H. Godshall, '93.
S. W. Goldschmidt, '03.
N. O. Goldsmith, '83.
F. Golian, '02.
O. S. Good, '97.
R. Goodman, '90.
W. T. Goodnow, '83.
W. R. Goss, '95.
R. C. Gotwald, '86.
E. G. Grace, '99.
J. W. Grace, jr., '99.
C. A. Gradwohl, '02.
*J. S. Graff, '96.
M. B. Graff, '94.
W. W. Graff, '01.
C. B. Graham, '03.
S. L. Graham, '93.
F. L. Grammer, '89.
W. Gratz, '98.
C. W. Gray, '81.
G. E. Greene, '90.
H. T. Greene, '00.
W. Griffith, '76.
J. S. Griggs, jr., '91.

E. A. Grissinger, '94.
R. S. Griswold, '97.
F. A. Groff, '00.
C. F. Gross, '00.
R. F. Gross, '02.
L. J. H. Grossart, '86.
W. H. Groverman, '96.
P. L. Grubb, '01.
W. B. Grubbe, '00.
*J. A. Gruver, '92.
W. Gummere, '99.
F. H. Gunsolus, '98.
B. Guthrie, '94.

H

W. N. Haas, '01.
M. S. Hachita, '02.
C. W. Haines, '74.
F. T. Haines, '95.
*H. S. Haines, '87.
J. F. Halbach, '75.
B. F. Haldeman, '81.
D. Hall, '96.
W. McC. Hall, '94.
W. R. Hall, '02.
F. D. Hallock, '94
T. G. Hamilton, '95.
M. S. Hanauer, '86.
W. T. Hanly, '97.
W. S. Hanna, '02.
*O. C. Hannum, '99.
A. B. Hanscom, '00.
H. Hardcastle, '88.
T. H. Hardcastle, '80.
W. G. Hare, '98.
S. T. Harleman, '01.
H. W. Harley, '90.
H. T. Harper, '84.
E. S. Harrar, '01.
G. W. Harris, '89.
L. S. Harris, '93.
G. A. Hart, '88.
W. D. Hartshorne, '74.
R. R. Harvey, '95.
S. J. Harwi, '86.
F. A. Hausman, '01.
G. S. Hayes, '91.
C. S. Haynes, '93.
H. W. Haynes, '03.
R. Hazel, '98.
S. C. Hazelton, '86.
W. C. Hazlett, '78.
R. W. Heard, '93.
D. G. Hearne, '90.
N. H. Heck, '03.
R. C. H. Heck, '93.
J. S. Hegeman, '02.
I. A. Heikes, '85.
J. S. Heilig, '91.
W. L. Heim, '02.
W. A. Heindle, '91.
J. G. Heinz, '00.
G. M. Heller, '77.
L. Henderson, '89.
T. L. Henry, '95.
A. W. Henshaw, '94.
A. A. Herr, '74.
H. N. Herr, '96.
J. F. Hersh, '91.
H. B. Hershey, '98.
J. W. Hertzler, '03.
H. D. Hess, '96.
H. H. Hess, '98.
*H. S. Hess, '95.
A. Y. Hesse, '94.
C. E. Hesse, '89.
H. V. Hesse, '91.
F. Hewett, '02.
W. S. Hiester, '97.
I. M. Higbee, '95.
E. Higgins, '02.
H. H. Hillegass, '84.
F. H. Hilliard, '94.
E. D. Hillman, '98.

C. F. Hinkle, jr, '03.
W. L. Hiss, jr., '95.
J. B. Hittell, '87.
J. D. Hoffman, '83.
E. F. Hofford, '84.
W. E. Holcombe, '94.
*J. S. B. Hollinshead, '90.
A. D. Hollingsworth, '00.
M. H. Holz, '94.
M. J. Honan, '00.
P. D. Honeyman, '91.
R. B. Honeyman, '88.
G. G. Hood, '83.
R. N. Hood, '97.
J. T. Hoover, '91.
C. C. Hopkins, '82.
W. Hopkins, '95.
G. L. Hoppes, '83.
H. J. Horn, '98.
G. A. Horne, '99.
L. S. Horner, '98.
R. R. Hornor, '99.
H. S. Houskeeper, '72.
F. K. Houston, '90.
J. M. Howard, '87.
F. P. Howe, '78.
M. A. DeW. Howe, '86.
R. P. Howell, '96.
A. A. Howitz, '94.
C. W. Hudson, '89.
E. M. Huggins, '00.
G. W. Hunsicker, '94.
R. Hunt, '03.
A. C. Hutchinson, '02.
G. C. Hutchinson, '94.

I

H. Ichikawa, '91.
*D. W. Irvine, '95.
H. T. Irwin, '97.

J

G. R. Jackson, '99.
W. S. Jackson, '96.
C. B. Jacobs, '95.
E. A. Jacoby, '95.
H. S. Jacoby, '77.
W. L. Jacoby, '92.
W. A. James, '95.
J. A. Jardine, '84.
H. S. Jaudon, '95.
W. H. Jaxheimer, '02.
S. H. Jencks, '88.
*G. A. Jenkins, '70.
A. P. Jenks, '97.
A. B. Jessup, '95.
A. E. Jessup, '92.
J. T. Jeter, '80.
J. J. Jimenez, '92.
E. B. John, '95.
W. S. Johns, '02.
A. T. Johnson, '99.
H. S. Johnson, '97.
V. A. Johnson, '96.
A. Johnston, '89.
A. B. Jones, '94.
B. H. Jones, '94.
C. C. Jones, '87.
H. H. Jones, '97.
H. E. Jordan, '03.
W. R. Jordan, '03.
A. E. Juhler, '91.
E. P. Jump, '01.
C. A. Junken, '86.

K

A. S. Kappella, '95.
D. Kautz, '95.
W. H. Kavanaugh, '94.
W. B. Keim, '95.
C. L. Keller, '93.
J. S. Kellogg, jr., '89.
J. W. Kellogg, '84.
H. Kemmerling, '91.
C. E. Kendig, '02.
J. M. S. Kerlin, '89.

D. G. Kerr, '84.
W. J. Kerr, '70.
E. A. Keys, '99.
H. E. Kiefer, '92.
W. F. Kiesel, jr., '87.
R. Kimball, '99.
C. F. King, '80.
H. E. Kip, '95.
R. R. Kitchel, '92.
J. W. Kittrell, '87.
A. W. Klein, '99.
J. H. Klinck, '99.
V. W. Kline, '96.
*L. E. Klotz, '72.
H. M. Knapp, '91.
F. N. Kneas, '98.
R. W. Knight, '94.
F. H. Knorr, '87.
S. B. Knox, '93.
B. G. Kodjbanoff, '98.
J. deB. Kops, '83.
J. B. Krause, '98.
L. G. Krause, '01.
R. E. Kresge, '96.
W. V. Kulp, '90.
H. M. Kurtz, '90.

L

S. W. Labrot, '92.
D. H. Lackey, '95.
N. Lafon, '78.
P. A. Lambert, '83.
S. E. Lambert, '89.
W. A. Lambert, '95.
O. M. Lance, '72.
H. K. Landis, '90.
W. S. Landis, '02.
R. S. Landron, '99.
C. A. Langdon, '94.
*S. D. Langdon, '87.
F. B. Langston, '84.
W. Langston, '84.
L. E. Lannan, '95.
G. L. de Lara, '86.
R. E. Laramy, '96.
W. A. Lathrop, '75.
S. T. Laubach, '01.
A. R. Laubenstein, '01.
F. C. Lauderburn, '91.
E. H. Lawall, '82.
J. P. S. Lawrance, '73.
T. H. Lawrence, '98.
J. W. Ledoux, '87.
L. R. Lee, '97.
H. Lefevre, '92.
J. E. Leibfried, '00.
G. C. Leidy, '00.
H. D. Leopold, '94.
C. McK. Leoser, jr., '91.
T. S. Leoser, '90.
W. G. Lessig, '00.
A. E. Lewis, jr., '88.
A. H. Lewis, '95.
G. Lewis, '95.
G. M. Lewis, '03.
H. S. Lewis, '00.
T. Lewis, '97.
J. J. Lincoln, '89.
G. B. Linderman, '87.
*R. P. Linderman, '84.
J. B. Lindsey, jr., '98.
F. F. Lines, '02.
A. E. Lister, '92.
J. E. Litch, '90.
F. J. Littell, '99.
J. E. Little, '94.
C. V. Livingston, '97.
W. J. Lloyd, '92.
J. Lockett, '89.
B. W. Loeb, '95.
F. S. Loeb, '93.
A. Long, '89.
A. F. Loomis, '97.
B. E. Loomis, '96.

C. A. Loomis, '98.
J. T. Loomis, '92.
C. G. Lord, '03.
W. Lord, '96.
T. P. Lovering, '95.
M. J. Luch, '02.
C. A. Luckenbach, '86.
C. O. Luckenbach, '94.
O. F. Luckenbach, '01.
T. W. Lukens, '00.
C. E. T. Lull, '00.
W. A. Lydon, '86.

M

J. B. MacBride, '96.
C. S. MacCalla, '96.
W. H. MacCarthy, '71.
W. T. McCarthy, '00.
H. D. McCaskey, '93.
H. H. McClintic, '88.
M. McClung, jr., '94.
J. A. McClurg, '91.
K. W. McComas, '00.
W. A. McFarland, '88.
C. W. Macfarlane, '76.
C. J. McGonigle, '01.
G. K. McGunnegle, '99.
H. L. McIlvain, '88.
R. A. McKee, '95.
C. L. McKenzie, '93.
F. A. McKenzie, '95.
S. T. McKenzie, '95.
O. G. MacKnight, '99.
B. MacNutt, '97.
J. D. McPherson, '94.
J. McVey, '02.
W. G. McVey, '00.
J. S. Mack, '88.
C. E. Maeder, '00.
R. W. Mahon, '76.
J. J. deG. Malcher, '76.
H. L. Manley, '92.
C. E. Marks, '03.
W. P. Marr, '93.
C. D. Marshall, '88.
L. H. Marshall, '98.
J. F. Marsteller, '77.
J. VanS. Martenis, '94.
C. E. Martinez, '01.
J. J. Martin, '89.
J. P. Martin, '00.
J. G. Mason, '97.
N. P. Massey, '95.
C. M. Masson, '99.
R. S. Masson, '92.
V. E. Masson, '96.
J. O. Mathewson, '94.
A. S. Maurice, '93.
C. F. Maurice, '95.
G. H. Maurice, '93.
A. E. Meaker, '75.
W. L. Meaker, '99.
W. A. Megraw, '97.
H. S. Meily, '87.
L. D. Menough, '01.
E. A. Mercenario, '97.
*J. F. Merkle, '84.
F. A. Merrick, '91.
*W. S. Merrill, '94.
T. Merriman, '97.
T. Merritt, '74.
J. F. Middledith, '99.
E. McC. Milheim, '02.
E. J. Millar, '92.
Charles Henry Miller, '88.
*Charles Henry Miller, '89.
Charles Herbert Miller, '90.
E. F. Miller, '83.
E. T. Miller, '03.
E. W. Miller, '96.
G. P. Miller, '88.
J. E. Miller, '93.
J. S. Miller, '95.
J. Z. Miller, '91.

W. H. Miller, '94.
*J. H. Millholland, '88.
P. D. Millholland, '86.
H. S. Miner, '88.
H. B. de Miranda, '73.
R. F. de Miranda, '72.
*S. Miyahara, '77.
C. W. Moffett, '89.
C. A. Moore, '94.
H. J. Moore, '01.
M. de la Mora, '00.
R. de la Mora, '96.
W. F. More, '83.
C. H. Morgan, '96.
E. R. Morgan, '03.
J. F. Morgan, '99.
W. L. Morgan, '02.
*C. F. Moritz, '98.
A. D. Morris, '95.
H. T. Morris, '91.
R. H. Morris, jr., '89.
W. E. Morris, '89.
J. Morrison, '75.
G. R. Morrow, '00.
H. S. Morrow, '88.
J. A. Morrow, '87.
J. T. Morrow, '89.
N. Morrow, '83.
R. T. Morrow, '82.
C. T. Mosman, '92.
D. L. Mott, '88.
F. D. Mount, '97.
E. T. Murphy, '01.
C. E. P. Murray, '02.
W. S. Murray, '95.
W. H. Mussey, '96.
H. K. Myers, '84.
J. H. Myers, '96.
W. H. Myers, '03.
W. F. Mylander, '93.

N

C. P. Nachod, '97.
G. Nauman, jr., '90.
W. L. Neill, '88.
*R. Neilson, '95.
H. S. Neiman, '88.
J. L. Neufeld, '94.
C. W. F. Neuffer, '94.
R. E. Neumeyer, '90.
C. A. Newbaker, '94.
C. G. Newton, '99.
H. H. Newton, '97.
D. K. Nicholson, '85.
T. Nicholson, '83.
*H. B. C. Nitze, '87.
R. C. Noerr, '97.
J. T. Nolan, '01.
B. B. Nostrand, jr., '78.
A. R. Nuncio, '84.

O

*J. A. de Obaldia, '98.
A. D. Oberly, '89.
F. Oberly, '96.
R. L. Ogden, '94.
J. F. O'Hearn, '94.
W. R. Okeson, '96.
C. L. Olmsted, '93.
L. A. Olney, '96.
*R. B. Olney, '92.
A. E. Olpp, '03.
J. M. O'Malley, '89.
C. J. O'Neill, '93.
G. Ordway, '94.
J. O'Reilly, '98.
H. Orth, jr., '92.
L. Ortner, '00.
N. M. Osborne, jr., '93.
R. E. Ozias, '92.

P

J. W. Packard, '84.
*H. E. Packer, '70.
H. C. Paddock, '98.
*J. H. Paddock, '79.
F. J. Paine, '03.
P. M. Paine, '91.
*H. Palmer, '88.
H. L. Palmer, '96.
*H. R. Palmer, '99.
M. P. Paret, '78.
C. J. Parker, '88.
C. W. Parkhurst, '93.
A. R. Parsons, '00.
F. W. Parsons, '02.
D. W. Patterson, '93.
G. S. Patterson, '83.
W. A. Payne, '94.
R. R. Peale, '83.
E. C. Pearson, '03.
E. J. Peck, '01.
*H. R. Peck, '97.
J. G. Peck, '93.
F. S. Pecke, '75.
J. H. Pennington, '97.
W. C. Perkins, '90.
F. A. Perley, '98.
R. S. Perry, '88.
*F. B. Petersen, '85.
J. G. Petrikin, '96.
G. F. Pettinos, '87.
J. R. Pettit, '99.
W. V. Pettit, '94.
J. H. Philips, '95.
A. E. Phillips, '90.
J. Phillips, jr., '95.
R. H. Phillips, '87.
F. W. B. Pile, '88.
C. Platt, '90.
J. S. Polhemus, '72.
*R. K. Polk, '87.
C. P. Pollak, '87.
M. W. Pool, '96.
H. F. J. Porter, '78.
R. H. E. Porter, '89.
H. A. Porterfield, '83.
A. Potter, '90.
G. E. Potter, '80.
S. C. Potts, '94.
J. L. Poultney, '95.
N. S. Powell, '00.
E. W. Pratt, '90.
M. D. Pratt, '87.
H. R. Price, '70.
J. B. Price, '85.
E. J. Prindle, '90.
F. H. Purnell, '83.
M. H. Putnam, '97.

Q

C. W. Quarrier, '98.
E. A. Quier, '91.
H. C. Quigley, '95.

R

L. T. Rainey, '99.
F. DeW. Randolph, '92.
R. B. F. Randolph, '93.
W. K. Randolph, '78.
*J. L. Rankin, '96.
R. S. Rathbun, '92.
A. G. Rau, '88.
C. R. Rauch, '77.
C. E. Raynor, '88.
R. H. Read, '78.
J. J. Reamer, '00.
V. C. Records, '98.
H. B. Reed, '70.
H. P. Reed, '96.
Percy Lawrence Reed, '98.
Percy Leslie Reed, '99.
W. M. Rees, '74.
A. K. Reese, '89.
J. N. Resse, '00.

*A. S. Reeves, '84.
H. A. Reid, '96.
J. G. Reid, '93.
V. H. Reid, '99.
J. R. Reigart, '03.
W. Reinecke, jr., '95.
E. T. Reisler, '87.
H. G. Reist, '86.
W. F. Rench, '91.
J. W. Reno, '83.
E. C. Reynolds, '93.
J. P. Reynolds, jr., '97.
S. A. Rhodes, '92.
W. P. Rice, '76.
F. E. Richards, '93.
G. T. Richards, '87.
H. Richards, '76.
J. W. Richards, '86.
L. W. Richards, '76.
W. P. Richards, '88.
*G. M. Richardson, '86.
O. Rickert, '88.
E. Rickseeker, '82.
W. C. Riddick, '90.
B. DeW. Riegel, '98.
J. I. Riegel, '92.
J. S. Riegel, '90.
S. S. Riegel, '97.
E. J. Rights, '95.
H. T. Rights, '95.
G. W. Ritchey, '93.
S. N. Riter, '95.
N. B. Robbinovitz, '03.
W. F. Roberts, '02.
G. L. Robinson, '03.
*M. Rock, '69.
T. C. Roderick, '94.
W. H. Rodney, '01.
F. W. Roebling, jr., '01.
A. L. Rogers, '89.
C. L. Rogers, '83.
J. D. Rogers, '03.
F. W. Roller, '94.
C. E. Ronaldson, '69.
*W. D. Ronaldson, '70.
D'A. W. Roper, '98.
*A. S. Ross, '86.
J. G. Ross, '00.
E. P. Roundey, '97.
*G. Rovelo, '99.
C. E. Rowe, '00.
H. W. Rowley, '85.
*C. W. Royce, '97.
*G. A. Ruddle, '86.
J. Ruddle, '83.
J. D. Ruff, '82.
C. L'H. Ruggles, '03.
G. H. Ruggles, '96.
C. B. Rutter, '94.
C. C. Rutter, '96.
J. C. Ryan, '01.

S

D. M. Sachs, '02.
F. B. Sage, '93.
A. L. Saltzman, '97.
J. E. Sanborn, '90.
A. Sanchez, '00.
A. J. Sanchez, '01.
R. F. Sanchez, '98.
C. F. Sanders, '97.
F. W. Sargent, '79.
E. T. Satchell, '00.
W. R. Sattler, '88.
V. Saucedo, '03.
*M. L. Saulsbury, '93.
A. C. Savidge, '01.
W. H. Sayre, jr., '86.
J. A. Schloss, '93.
F. R. Schmid, '03.
R. Schmitz, '91.
E. A. Schnabel, '91.
A. Schneider, '92.
H. Schneider, '94.

B. F. Schomberg, '94.
A. Schotte, '93.
C. W. Schwartz, jr., '89.
H. C. Schewecke, '98.
E. Schwinghammer, '95.
C. F. Scott, '97.
H. H. Scovil, '00.
H. D. Scudder, '72.
W. McI. Scudder, '73.
*J. W. Scull, '87.
H. H. Seabrook, '97.
B. Searle, '84.
H. K. Seltzer, '95.
W. F. Semper, '93.
J. B. Semple, '92.
L. B. Semple, '84.
S. P. Senior, '97.
A. H. Serrell, '97.
J. C. Sesser, '96.
E. E. Seyfert, '94.
J. W. Shaeffer, '01.
*W. Shapleigh, '71.
A. B. Sharpe, '93.
F. B. Sheaffer, '97.
C. K. Shelby, '92.
L. R. Shellenberger, '91.
*A. Y. Shepherd, '96.
G. E. Shepherd, '94.
D. F. B. Shepp, '98.
J. L. Sheppard, jr., '97.
H. J. Sherman, '90.
J. E. Shero, '95.
A. Shimer, '99.
I. A. Shimer, '91.
C. E. Shipley, '94.
E. H. Shipman, '88.
W. C. Shoemaker, '90.
L. D. Showalter, '96.
H. Shriver, '96.
J. C. Shriver, '92.
J. S. Shultz, '00.
E. P. Shuman, '97.
*S. B. Sickler, '82.
J. S. Siebert, '86.
R. S. Siegel, '95.
E. H. Sigison, '95.
J. A. Simons, '02.
R. N. Skillman, '03.
J. B. Slack, '95.
J. E. Slade, '97.
W. P. Slifer, '02.
A. P. Smith, '84.
D. Smith, '03.
D. R. Smith, '03.
*E. O. Smith, '85.
F. B. Smith, '97.
F. S. Smith, '87.
N. W. Smith, '93.
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